Range Plant Communities and Range Health Assessment Guidelines for the

Mixedgrass Natural Subregion of Alberta

Mixedgrass Range Plant Community Guide

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RANGE PLANT COMMUNITIES AND RANGE HEALTH ASSESSMENT GUIDELINES FOR THE MIXEDGRASS NATURAL SUBREGION OF ALBERTA

First Approximation

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Executive Summary

The Mixedgrass Natural Subregion is a zone of transition between the Great Plains and fescue grasslands of the Foothills Fescue and Foothills Parkland Natural Subregions. The Mixedgrass accounts for 19.8% of the Grassland Natural Region area, and 2.9% of the area of Alberta. Approximately 31% of the original 4.6 million acres of Mixedgrass prairie remain today.

This, and other plant community guides in the series, replace the original Guide to Range Condition and Stocking Rates for Alberta Grasslands by Wroe et al. (1988). The guide is designed for use with the field workbook - Range Health Assessment for Grassland, Forest and Tame Pasture (Adams et al. 2003). A new feature of this guide is a soil correlation mechanism that provides more guidance in determining range site, an important link to range plant communities. The guide should be used with published soil survey information or AGRASID (Agricultural Regions of Alberta Soil Information Database). Other site information like landscape, soil features and textural groupings will aid in range site determination.

Relevant grazing research is summarized especially from the Agriculture and Agri-Food Research Substation at Manyberries. Although much of this work has been undertaken in the Dry Mixedgrass, many aspects of this research will have application in the dark brown soil zone as well. Past range plant community studies are also reviewed.

This first approximation will address the most extensive and common grassland and shrub plant communities in Mixedgrass. The analysis evaluated 724 vegetation plots and distinguished 42 plant communities of which 34 were native grassland or shrub types and eight were modified grassland types. Plant communities are reported in three categories. The reference plant communities are considered to represent the potential natural community for the site in question. Native successional and modified communities are identified where possible, in relation to the reference plant community. These communities reflect the impact of variation in frequency and intensity of disturbance to the reference plant community. Ecologically sustainable stocking rates are provided for each plant community type. Future studies will address riparian plant communities and other range sites of lesser extent on the landscape. The report also includes consolidated guidelines and scoring notes for range health assessment in the Mixedgrass.

Contributors

Special thanks to Dennis Milner in evaluating long term stocking records. Other contributors include Nancy Boutillier, Jennifer Carlson, John Carscallen, Terry Hood, Greg McAndrews, Ken Pitcher, Jake Willms, Alberta Sustainable Resource Development; Clare Tannas, Eastern Slopes Rangeland Seeds; Alan Robertson, High Range Ecological Consultants; Varge Craig, Alta Rangeland Services.

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We wish to acknowledge Michael Willoughby, ASRD, Edmonton, for his leadership in the development of range plant community classifications for a significant portion of Alberta's rangelands. We also wish to express our sincere thanks for his council and assistance on methods and procedures.

Development of plant community guides for the grassland natural region has been possible because of the large and growing body of high quality vegetation plot data collected by Range Management program staff and a number of rangeland consultants since 1986 when the Southern Range Inventory project was established, primarily to collect range plant community information for management planning. These professionals have payed particular care and attention to accurate plant taxonomy and consistent application of inventory methods. We wish to acknowledge the high quality of range vegetation inventory data that has been collected for the Public Lands Division by Kathy and Clare Tannas (Eastern Slopes Rangeland Seeds, Cremona, AB), Alan Robertson (High Range Ecological Consultants, Edmonton, AB) and Bryne Weerstra (Biota Consultants, Cochrane, AB).

Thanks to Dr. Walter Willms and Dr. John Dormaar, Agriculture and Agri-Food Canada for their friendship, inspiration and constant encouragement.

Comments on the First Approximation

The first approximation is provided to define the major native and modified grassland communities and a limited number of shrub communities for the Mixedgrass Natural Subregion. This will provide an initial plant community guide to provide basic standards for assessing range health using the new range health assessment protocol (Adams et. al 2003). The first approximation guides in the grassland natural region provide plant community information in a similar format to the plant community guides developed by Willoughby et. al (2003) for Boreal and Rocky Mountain natural regions thus ensuring a more standardized format province-wide.

A new feature of guides in the grassland natural region will be an improved framework for correlating soils information to range site and plant community. A strength of the original stocking guide (Smoliak et. al 1966, Wroe et. al 1988) was the use of generic range sites definitions that allowed users to recognize site potential. The new system

builds on the old framework but provides more objectivity in determining range site.

Recently Thompson and Hansen (2002) have classified riparian and wetland plant communities in the Grassland Natural Region. The 2nd approximation will integrate this information with the range plant communities described here. Additional research is required beforehand to permit correlation with more specific soils information.

USING THE GUIDE - MAJOR TOPICS

Determining Ecological Range Sites

To use this plant community guide, you will need information about the dominant and subdominant soils for the landscape you are interested in within the Mixedgrass Natural Subregion. Identification of the potential natural community (or reference plant community) for a site begins by recognizing the ecological range site. Range site is identified through **key attributes of the landscape**, of **soil features** and by **textural groupings**.

Important! - Review the reference materials identified in this chapter, especially AGRASID 3.0[1] (Agricultural Regions of Alberta Soil Information Data Base)

Chapter 2.0 provides a detailed review of physiography, climate and soils of the Mixedgrass Natural Subregion:

- General overview of physiography, climate and soils in the Mixedgrass.....page 3
- General definitions for ecological range sites - Appendix 9.1.....page 91
- Correlation of soils and ecological range sites .....page 11
- Procedure for determining range sites .....page 16
- Appendix 9.2 A Concise Guide to Assist Users of AGRASID .....page 93

Review of Literature

Previous grazing studies and plant community studies are reviewed in chapters 3 and 4 of the report:

- Grazing research in the Mixedgrass and Dry Mixedgrass .....page 20
- Previous plant community studies in the Mixedgrass .....page 24

Range Plant Communities (Reference, Successional and Modified) and Suggested Carrying Capacities

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[1] To obtain a copy of AGRASID 3.0 go to:
http://www.agric.gov.ab.ca/soil/agrasid/agrasidmainpage.html

The KEY to range plant communities is on the following page.
Chapter 6 is the core chapter describing range plant communities within the Mixedgrass, their successional relationships, suggested carrying capacities and detailed plant community descriptions:

- Summary table of reference, successional and modified plant communities .....pages 30-34
- Summary of range plant communities and suggested carrying capacities .....pages 35-37
- Description of **native grassland communities** .....pages 38-66
- Description of **modified grassland communities** .....pages 67-73
- Description of **shrub communities** .....pages 74-79

Guidelines for Assessing Range Health in the Mixedgrass Natural Subregion

- Guidelines for assessing ecological status, plant community structure, soil exposure, litter abundance and noxious weeds in the Mixedgrass Natural Subregion .....page 80

Key to Range Plant Communities

Plant Community Categories

1. Native grasslands found in the Mixedgrass ..... **Native Grassland Key**
   Plant communities are modified to non-native species or are shrub communities..... 2
2. Plant communities dominated by non-native species like Kentucky bluegrass, awnless brome, crested wheatgrass, noxious weeds or weedy disturbance species ..... **Modified Grassland Key**
   Plant communities have more than 5% canopy cover of silver sagebrush, common wild rose or snowberry..... **Shrub Community Key**

Native Grassland Key

1. Native grassland is located in the Cypress Hills or Sweetgrass Uplands..... 3
   Native grassland is located in other ecodistricts..... 2
2. Native grassland is located in the Milk River Upland..... 12
   Native grassland is located in the Lethbridge, Vulcan, Majorville, Standard or Blackfoot Plain..... 21
3. Native grassland is dominated by rough fescue..... 4
   Native grassland is dominated by western porcupine grass, northern or western wheatgrass, needle-and-thread or salt grass 6
4. Native grassland is dominated by rough fescue and is a thin breaks, gravel or shallow to gravel range site..... 5
   Native grassland is dominated by rough fescue with a loamy range site..... **Plains Rough Fescue-Western Porcupine Grass-Sedge MGA1**
5. Native grassland is dominated by rough fescue on a thin breaks range site ..... **Plains Rough Fescue - Plains Muhly MGA8**
   Native grassland is dominated by rough fescue on a shallow-to-gravel or gravel range site..... 5a

5a. Native grassland is dominated by rough fescue on a shallow to gravel range site..... **Plains Rough Fescue - Northern Wheatgrass- Western Porcupine Grass MGA31**
   Native grassland is dominated by rough fescue on a shallow-to-gravel or gravel range site..... **Plains Rough Fescue-June Grass-Northern Wheatgrass MGA7**

6. Native grassland is dominated by western porcupine grass..... 7
   Native grassland is dominated by needle-and-thread, northern or western wheatgrass or salt grass..... 8
7. Native grassland is a loamy range site at medium to upper elevations and rough fescue is present ..... **Western Porcupine Grass-Plains Rough Fescue- MGA2**
   Native grassland is a loamy range site a medium to low elevations and rough fescue is not present, or in only trace amounts..... **Western Porcupine Grass-Northern Wheatgrass-June Grass MGA30**
8. Native grassland is dominated by needle-and-thread grass..... 9
   Native grassland is dominated by northern wheatgrass, western wheatgrass or salt grass..... 11
9. Native grassland is dominated by needle-and-thread grass and is a loamy range site..... 10
   Native grassland is dominated needle-and-thread grass and is a blowout range site ..... **Needle-and-Thread Grass-Plains Rough Fescue-Northern Wheatgrass MGA5**
10. Native grassland is a loamy range site at upper elevations..... **Needle-and-Thread-June Grass MGA3**
    Native grassland is a loamy range site at medium to lower elevations ..... **Needle-and-Thread-Northern Wheatgrass-June Grass MGA4**
11. Native grassland is dominated by northern wheatgrass on a blowout range site with or without silver sagebrush pre ..... **Silver Sagebrush/Northern Wheatgrass-June Grass MGA9**
    Native grassland is dominated by salt grass on a saline lowland range site ..... **Salt grass-Sedge-Western Wheatgrass MGA6**
12. Native grassland is dominated by Idaho fescue..... 13
    Native grassland has is dominated by other native grasses..... 14
13. Native grassland is dominated by Idaho fescue and northern wheatgrass.....

Idaho Fescue-Northern Wheatgrass-Needle-and-Thread MGA10

Native grassland is dominated by Idaho fescue and grazing resistant forbs like lupine

Idaho Fescue-Lupine MGA11

14. Native grassland is dominated by needle-and-thread grass 15
    Native grassland is dominated by northern wheatgrass, western wheatgrass, salt grass or bluegrasses.. 16
15. Native grassland is a loamy range site at medium to lower elevations
    Needle-and-Thread-Northern Wheatgrass-June Grass MGA14
    Native grassland is a sandy range site at medium to lower elevations
    Needle-and-Thread-Northern Wheatgrass-Sandgrass MGA16
16. Native grassland is dominated by bluegrass species 17
    Native grassland is dominated by northern wheatgrass, western wheatgrass or salt grass 18
17. Native grassland is loamy site dominated by Kentucky bluegrass and Idaho fescue
    Snowberry/Kentucky bluegrass-Idaho Fescue MGA12
    Native grassland is dominated Canada bluegrass and grazing resistant forbs like lupine
    Canada Bluegrass-Lupine MGA13
18. Native grassland is a dominated by northern or western wheatgrass 19
    Native grassland is a saline lowland site dominated by salt grass and wheatgrass species
    Salt Grass-Western Wheatgrass-Sedge MGA19
19. Native grassland is a blowout range site dominated by western wheatgrass
    Western Wheatgrass-June Grass-Sedge MGA17
    Native grassland is thin breaks range site dominated by northern wheatgrass and needle-and-thread 20
20. Native grassland is dominated by northern wheatgrass on a blowout range site with or without silver sagebrush present ..... **Silver Sagebrush/Northern Wheatgrass-June Grass MGA9**
    Native grassland is dominated by salt grass on a saline lowland range site
    Salt grass-Sedge-Western Wheatgrass MGA6
21. Native grassland is dominated by northern or western wheatgrass 22
    Native grassland is dominated by seral grasses like blue grama, needle-and-thread, low sedge or salt grass 23
22. Native grassland is a loamy range site and dominated by northern or western wheatgrass and needle-and-thread grass ..... **Wheatgrass-Needle-and-Thread MGA21**
    Native grassland is a sandy range site and is dominated by northern or western wheatgrass
    Snowberry/Northern Wheatgrass-Needle and Thread MGA25
23. Native grassland is dominated by needle-and-thread grass 24
    Native grassland is dominated by blue grama, low sedge or salt grass. 26
24. Native grassland is dominated by needle-and-thread and is a loamy range site
    Needle-and-Thread-June Grass MGA22
    Native grassland is a sand or sandy range site 25
25. Native grassland is dominated by needle-and-thread and is a sandy range site
    Needle-and-Thread-Low Sedge-Pasture Sagewort MGA24
    Native grassland is dominated by needle-and-thread grass and is a sand range site
    Snowberry/Needle-and-Thread-Sand grass-Low Sedge MGA28
26. Native grassland is a saline lowland dominated by salt grass
    Salt grass-Foxtail Barley-Wheatgrass MGA29
    Native grassland is dominated by ≥ 1 grasses like blue grama or low sedge 27
27. Native grassland is dominated by blue grama grass 28
    Native grassland is dominated by low sedge and is a sandy range site
    Low Sedge-Pasture Sagewort-Northern Wheatgrass MGA26
28. Native grassland is a loamy range site dominated by blue grama
    Blue Grama-Needle-and-Thread MGA23
    Native grassland is a sandy range site and is dominated by blue grama
    Blue Grama-Low Sedge-Needle-and-Thread MGA27

Modified Grassland Key

1. Plant community is dominated by Kentucky bluegrass 2
   Plant community is dominated by invasive non-native grasses including awnless brome, crested wheat-

grass or Canada thistle.....3

2. Plant community is dominated by Kentucky bluegrass on an overflow range site
.....**Snowberry/Kentucky Bluegrass-Tufted Hairgrass MGB2**
Plant community is dominated by Kentucky bluegrass on a sandy range site
.....**Kentucky Bluegrass-Common Dandelion-Awnless Brome MGB5**

3. Plant community is dominated by awnless brome 4
Plant community is dominated by crested wheatgrass or Canada thistle.....6

4. Plant community is dominated by awnless brome with a loamy range site 5
Plant community is dominated by awnless brome on a sandy range site.....
.....**Awnless Brome-Sand Grass MGB4**

5. Plant community is on a loamy range site and dominated by awnless brome, Alfalfa and Kentucky bluegrass.....**Awnless Brome-Alfalfa-Kentucky Bluegrass MGB3**
Plant community is on a loamy range site and is dominated by awnless brome and Kentucky bluegrass with or without a minor canopy of snowberry **Snowberry/Awnless Brome-Kentucky Bluegrass MGB7**

6. Plant community is dominated by crested wheatgrass. 7
Plant community is on a loamy range site and is dominated by Canada thistle and Kentucky bluegrass
.....**Snowberry/Canada Thistle-Kentucky Bluegrass MGB8**

7. Plant community is on a loamy upland range site and is dominated by crested wheatgrass and pasture sagewort.....**Crested Wheatgrass-Pasture Sagewort MGB1**
Plant community is on a loamy range including alluvial terraces and is dominated by crested wheatgrass with a minor canopy of snowberry.....**Snowberry/Crested Wheatgrass-Pasture Sagewort MGB6**

Shrub Community Key

1. Shrub community is a dominated by snowberry 2
Shrub community is on a blowout range site and is dominated by silver sagebrush and northern or western wheatgrass.....**Silver Sagebrush/Western Wheatgrass-June Grass MGC1**

2. Plant community is on an loamy or thin breaks range site.....3
Plant community is on an overflow range site and is dominated by snowberry and green needle grass
.....**Snowberry/Green Needle Grass-Kentucky Bluegrass MGC2**

3. Plant community is on a loamy range site 4
Plant community is on a thin breaks range site and is dominated by snowberry and thread-leaved sedge
.....**Snowberry/Thread-leaved Sedge-June Grass MGC3**

4. Plant community is dominated by snowberry and pasture sagewort or low sedge 5
Plant community is a dominated by snowberry and needle-and-thread grass
.....**Snowberry/Needle-and-Thread-Low Sedge-Northern Wheatgrass MGC4**

5. Plant community is dominated by snowberry and low sedge
.....**Snowberry/Low Sedge-Northern Wheatgrass MGC5**
Plant community is a dominated by snowberry and pasture sagewort
.....**Snowberry/Pasture Sagewort-Low Sedge MGC6**

1.0 Introduction and Background

1.1 This Guide - An Aide to Rangeland Health Assessment

This plant community guide is provided as an essential reference for range health[2] assessment in the Mixedgrass Natural Subregion of Alberta. Range health assessment (Adams et al. 2003) is a new approach that builds on the traditional range condition concept that considers plant community type in relation to site potential, but also adds new indicators of important natural processes and functions.

Range management strives to protect and enhance the soil and vegetation complex while maintaining or improving the output of consumable products along with a wide range of other values and natural functions. Ranchers and resource managers have used the concept of range condition in Alberta to measure any deterioration that has taken place within a range plant community due to disturbances especially from livestock grazing. Range condition has been rated in relation to a concept of site potential or climax vegetation. The first stocking guide for the grassland natural region The Guide to Range Condition and Stocking Rates for Alberta Grasslands, was patterned after the US Department of Agriculture - Soil Conservation Service "range site" concept (Smoliak et al 1966, Wroe et al 1988). Since the first guide was published, several generations of ranchers and range resource managers have developed an understanding of range sites and the ecological conditions that they represent. The new range health tools are similarly intended for use by range resource managers and rancher and for a wide variety of other groups and users that share an interest in healthy rangelands.

Range managers generally strive to maintain plant communities at late-seralor higher successional stages (e.g. climax to potential natural community), in order to provide higher levels of ecological functioning and to sustain an optimum flow of products like livestock forage. Healthy range plant communities perform important ecological functions and provide a broader suite of goods and services than lower seral stages. Early-and mid-seral stages need to be present in the landscape to represent the full range of natural variation that existed prior to European settlement, but should not be predominant.

Our use of the term "range health" instead of "range condition" flags a change in approach that builds on the traditional range condition concept. The new approach also considers plant community type in relation to site potential, but adds new indicators of natural processes and functions, important functions performed by healthy rangelands. We use the term range health to mean the ability of rangeland to perform certain ecological functions. These functions include:

[2]The range health approach is being adopted in the United States and Canada by a variety of agencies and organizations including the Natural Resource Conservation Service (NRCS), the US Forest Service and the Bureau of Land Management (Butler et al 1997, Busby et al 1994, and Task Group on Unity in Concept and Terminology 1995). The Alberta Rangeland Health Assessment project will provide new rangeland monitoring tools for Alberta rangelands (Willoughby et al. 1999).

- net primary production
- maintenance of soil/site stability
- capture and beneficial release of water
- nutrient and energy cycling and
- plant species functional diversity

Healthy rangelands will provide sustainable grazing opportunities for livestock producers and also sustain a long list of others products and values. Declines in range health will alert the range manager to the need for management changes.

1.2 Ecological Range Sites and Grassland Plant Communities

Range health is measured by comparing the functioning of ecological processes on an area of rangeland to a standard known as an **ecological site description**. An **ecological site** is similar to the concept of **range site**, but a broader list of characteristics are described. *An **ecological site** as defined by the Task Group on Unity and Concepts (1995), "is a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation".* This is similar to the ecosite/ecosite phase concept described by Beckingham and Archibald (1996) largely applied in the forested portions of the Rocky Mountain, Foothill and Boreal Forest Natural Regions where forest cover provides a valuable aide to community classification.

Ecological classification systems are an important tool for resource managers (Beckingham and Archibald 1996, Willoughby et. al 2003) and they:

- help us to organize what we know about ecosystems
- provide resource managers with a common language for range resource management and planning
- facilitate ecologically-based decision making
- help us to understand and refine resource potentials and carrying capacities over time.

Early grassland studies in the 1940's and 1950's (Clark et. al 1943, Coupland 1950, 1961) provided a broad and generalized understanding of prairie grassland communities, but a comprehensive classification of Alberta grassland natural region has never been completed. An ecological classification system must provide a method for identifying site potential and to help predict where a particular plant community is likely to occur in the landscape. In a forest setting, forest canopy provides important evidence of growing conditions and site potential. In grassland environments, soils information is essential to predicting the potential natural community especially where disturbance history may limit the resource manager's understanding of the ecological status of the current plant community vs. the potential for the site. In range health assessment, we refer to the plant community that is an expression of site potential as the reference plant community (RPC) since this is the community that acts as a standard for comparison in range health assessment.

With the development of AGRASID (Agricultural Region of Alberta Soil Inventory Database, ASIC 2001), it is possible to establish site and soil characteristics within an acceptable degree of accuracy from the AGRASID digital soils data base for lands in the agricultural settlement area of the province. The soil/range site correlation tables developed by LandWise Inc. (1998, 2001), provide a crosswalk that allows users to apply information about soils and other landscape variables to establish range sites. Ecological range site descriptions are used to predict reference plant communities as well as successional stages resulting from disturbance.

Grassland plant communities are defined in an ecological classification system in a similar fashion to forest communities by grouping vegetation data (from research plots and range surveys) "into similar functional units that respond to disturbance in a similar and predictable manner (Beckingham and Archibald 1996)". In the classification process that we use in this project, we begin by correlating recognizable plant communities with a broad range site definitions, like Loamy, Overflow or Blowout. If more than one plant community is correlated with a given range site type, we then make further subdivisions of the range site type based on variability within the range site definition. For example, over the breadth of a natural subregion, the variation in Loamy soils might be further subdivided on variation in temperature and precipitation which in turn is reflected in the plant community. Loamy sites near the moist end of the natural subregion might be described as Loamy 1 and the driest in the sequence would be Loamy^{n}. An **ecological range site** then would be the combination of the plant community name and the subdivsion of the range site (Loamy 1 - Plains Rough Fescue - Western Porcupine Grass).

The plant communities presented in this report represent the first approximation for the soil correlation areas (SCAs) and natural subregions in question and will be further revised and refined with additional plant community studies.

2.0 Physiography, Climate and Soils of the Mixedgrass Natural Subregion

2.1.1 Overview[3]

The Mixedgrass Natural Subregion is one of four Natural Subregions in the Grassland Natural Region (Achuff 1994), along with the Dry Mixedgrass, Foothills Fescue, and Northern Fescue (Fig. 1). The Mixedgrass accounts for 19.8% of the Grassland Natural Region area, and 2.9% of the area of Alberta (ASIC 2001). Approximately 31% of the original 4.6 million acres of Mixedgrass prairie remain today.

The Mixedgrass Natural Subregion occurs in four geographic areas. The largest area (78.3% of the Mixedgrass, ASIC 2001) occurs on the plains, including the towns or cities, from south to north, of Warner, Lethbridge, Vulcan, and Gleichen, and extending to the Wintering Hills near Hussar. Smaller areas of Mixedgrass occur in three highland

[3] For a detailed description of physiography, climate and soils of the Grassland Natural Region, see McNeil (2004).

areas to the southeast: 1) surrounding the Cypress Hills Escarpment and Plateau; 2) the Sweetgrass Hills Upland; and 3) the eastern portion of the Milk River Ridge.

The boundaries of the Mixedgrass Natural Subregion correspond closely to the boundaries of the Agricultural Regions of Alberta Soil Information Database (AGRASID) Soil Correlation Areas (SCAs) 2 and 3 (ASIC 2001). The plains portion of the Mixedgrass Natural Subregion is correlated with SCA 3, while the three highland areas are correlated with SCA 2 (Fig1).

The Mixedgrass Natural Subregion includes eight Ecodistricts[4] (Fig. 2). Highland Ecodistricts in SCA2 are the Cypress Hills, Sweetgrass Upland, and the Milk River Upland. Plains Ecodistricts in SCA3 include the Lethbridge Plain, Vulcan Plain, Blackfoot Plain, Majorville Upland and Standard Plain. Two isolated highland areas within the Vulcan Plain (the Buffalo Hill Upland) belong to the Foothills Fescue Natural Subregion.

The Mixedgrass Natural Subregion is dominated by Dark Brown Chernozemic soils (Table 1). Parent materials are dominantly glacial till with lesser occurrence of glacio-lacustrine, glacial-fluvial and eolian parent materials. Topography in the Plains ecodistricts is dominantly undulating. Hummocky topography is also common, while topography in the highland ecodistricts is dominantly hummocky to inclined (Fig. 3).

[4] Ecodistricts are based on distinct physiographic and/or geologic patterns. They are distinguished by similar patterns of relief, geology, geomorphology and genesis of parent material.

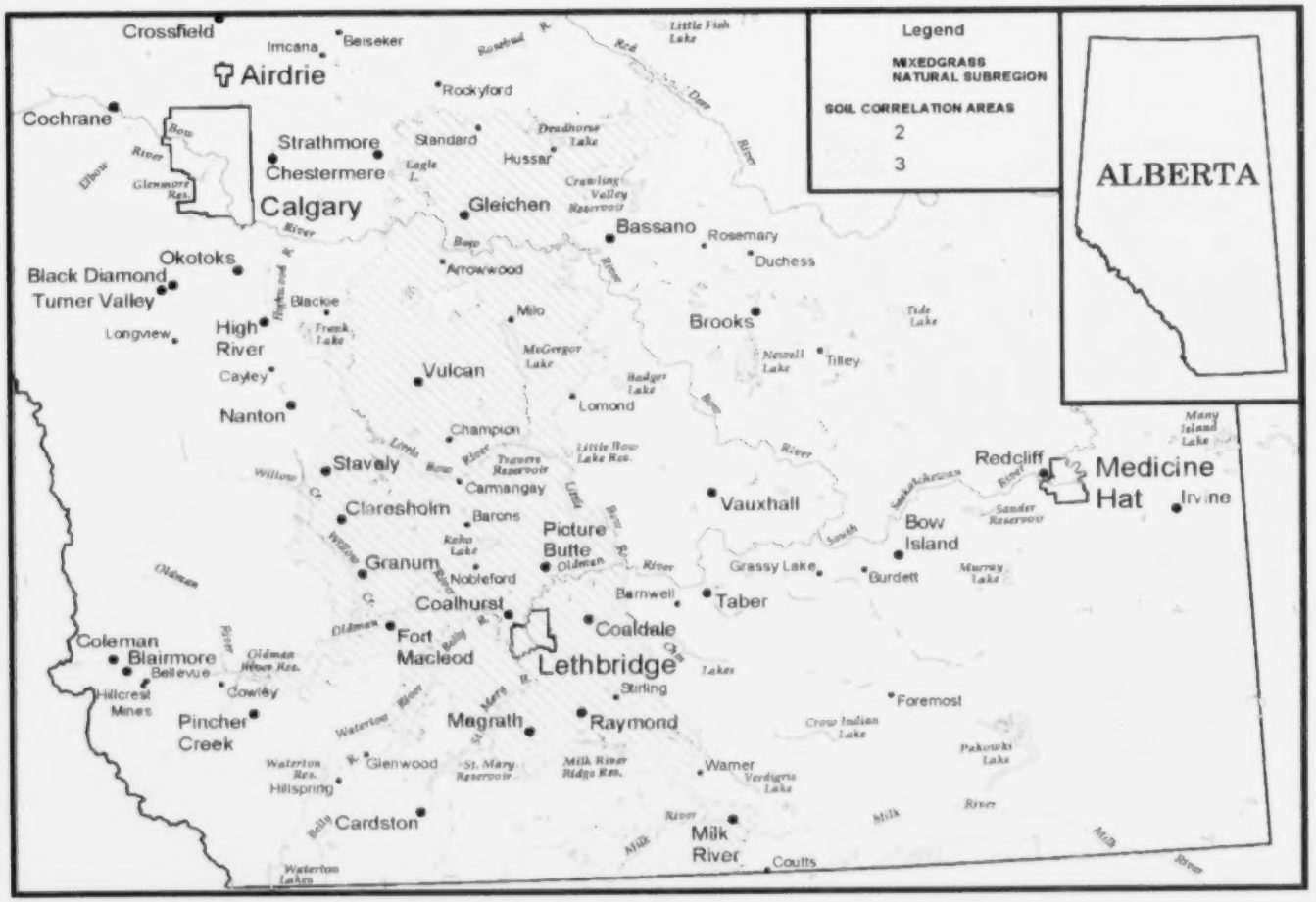

Figure 1 Mixedgrass Natural Subregion in Relation to Soil Correlation Areas 2 and 3

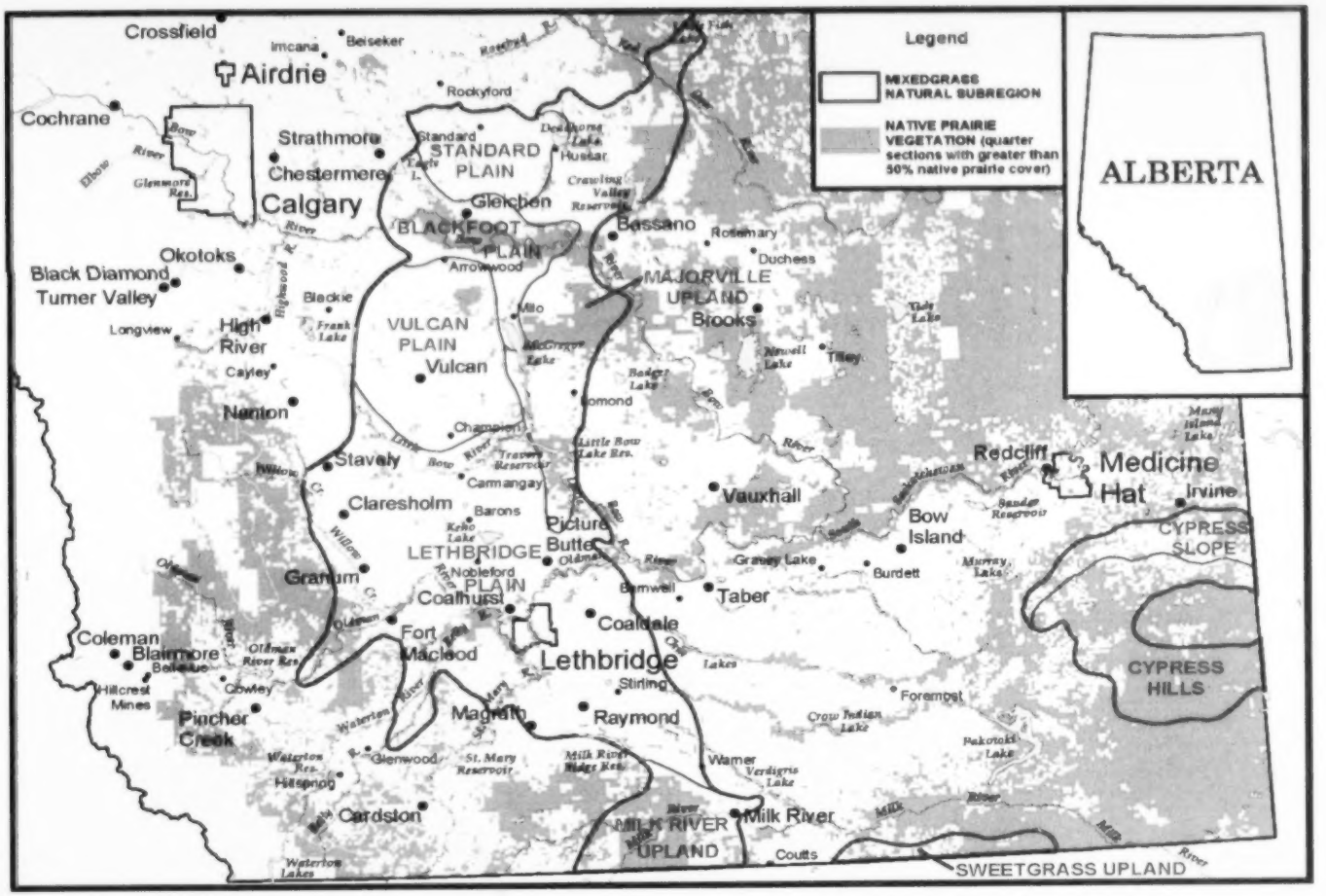

Figure 2: Ecodistricts in the Mixedgrass Natural Subregion

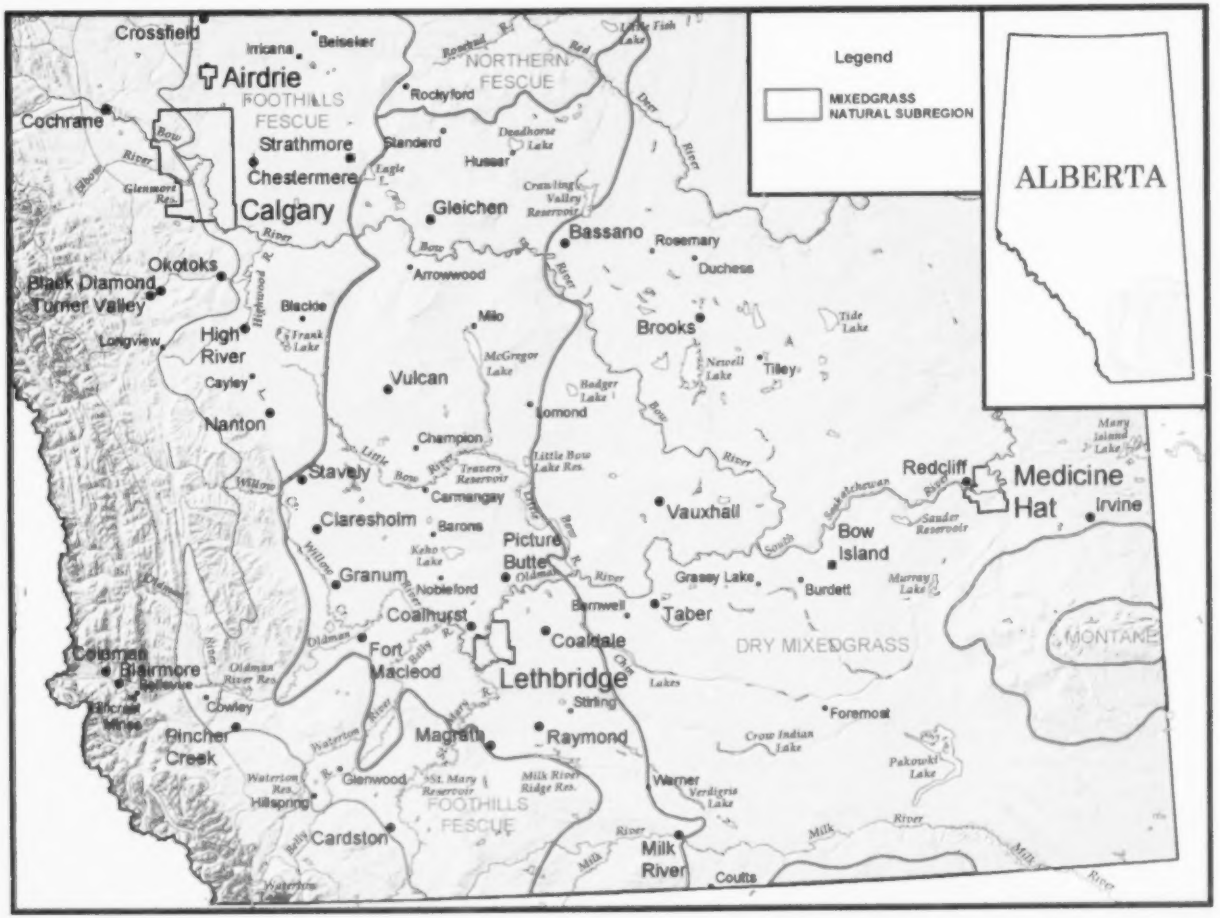

Figure 3. Mixedgrass Natural Subregion with Hillshade Model (Digital Elevation Model)

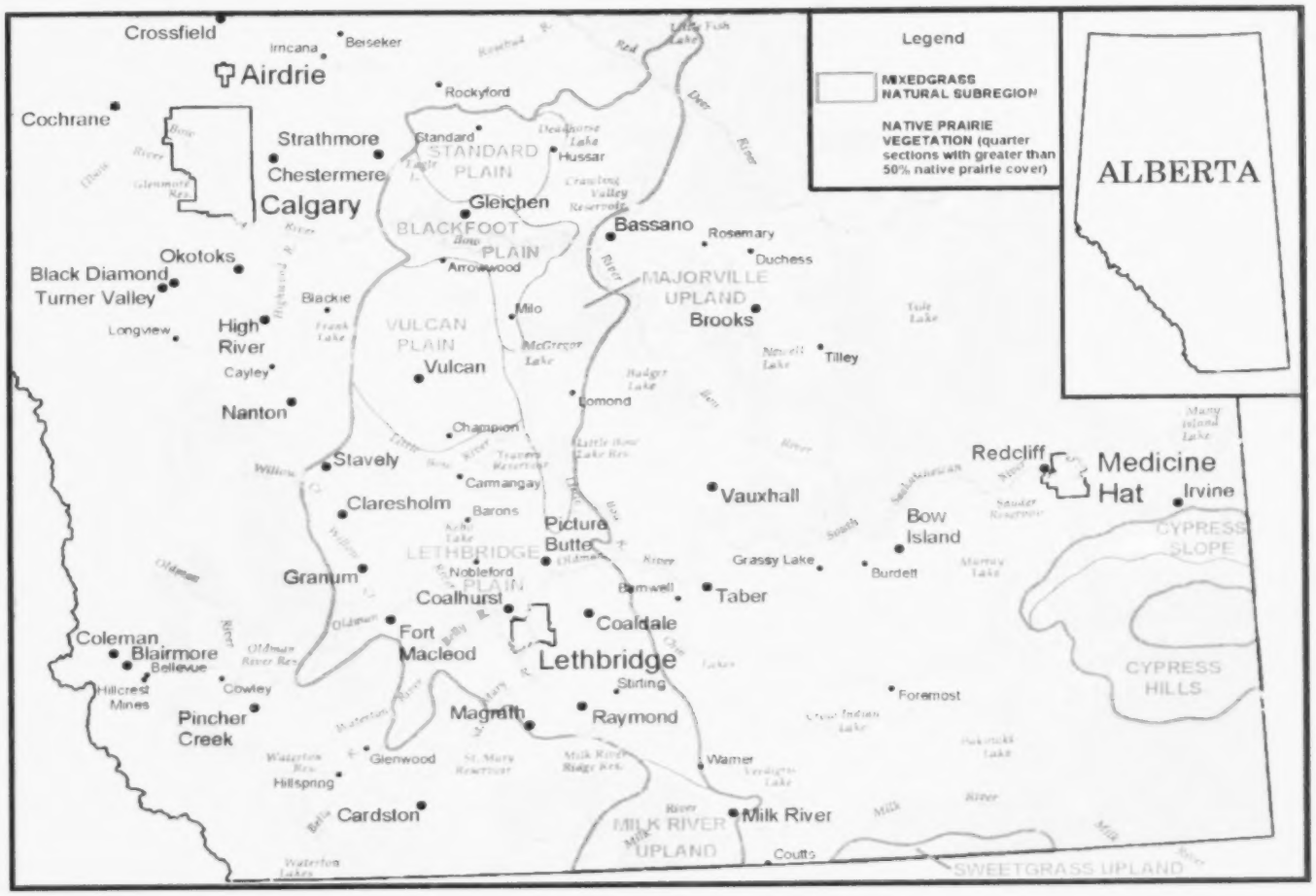

Figure 2 Ecodistricts in the Mixedgrass Natural Subregion

Figure 3. Mixedgrass Natural Subregion with Hillshade Model (Digital Elevation Model)

Drainage on the plains is to the South Saskatchewan River system, via the Bow and Oldman Rivers and their tributaries. The northern part of the Cypress Hills and the Milk River Ridge also drain to the South Saskatchewan River, but the southern portion of each of these areas, along with the entire Sweetgrass Hills upland area, drain to the Milk River/Missouri system.

Table 1. Key distinguishing features of the Mixedgrass Natural Subregion compared with neighbouring Natural Subregions.

Natural Subregion	Dominant Soils	Dominant Vegetation	General Climate compared to Mixedgrass
MixedGrass	Dark Brown Chernozemic	Wheat grasses and Needle and Thread grass.	Dry, with warm summers; subject to chinooks.
Foothills Fescue	Black Chernozemic	Rough Fescue	Moister; less evaporation. Chinooks are stronger. Higher frequency of snowfall in late winter and early spring (Achuff 1994).
Dry Mixedgrass	Brown Chernozemic	Blue grama and Needle and Thread grass	Drier, with warm to hot summers; chinooks occur on about 20 to 30 fewer days. 20% less precipitation (Achuff 1994).
Northern Fescue	Dark Brown Chernozemic and Dark Brown Solonetz	Rough Fescue	Colder, more continental, drier and few chinooks

The level and undulating and low-relief hummocky landscapes of the Mixedgrass Natural Subregion are largely devoted to crop agriculture. The Plains ecodistricts are extensively cultivated, with the exception of the Majorville Upland and the Blackfoot Plain, which contain about 30 to 40% native range. The Upland ecodistricts contain approximately 60 to 70 % native range.

2.1.2 Climate[5]

The climate in the Mixedgrass Natural Subregion is characterized by short summers with warm days and cool nights, and long cold winters. The mean annual temperature is about 5°C, with a mean summer temperature of about 15°C, which is 1 to 2°C cooler than in the Dry Mixedgrass Natural Subregion.

The Mixedgrass Natural Subregion experiences strong chinooks, but to a lesser intensity than in the Foothills Fescue. Chinooks are an intense dry westerly or southwesterly wind created by the orographic rise of westerly air masses over the Rocky Mountain divide. The air masses release precipitation on the west side of each mountain range in the

[5] For a detailed description of physiography, climate and soils of the Grassland Natural Region, see McNeil (2004).

western cordillera. Energy is gained each time precipitation is released, ultimately resulting in a strong westerly wind in southwestern Alberta. The maximum wind speed measured at the Lethbridge airport between 1971 and 2000 was 171 km/hr (Environment Canada 2002). Wind speed is not recorded at other weather stations in the Mixedgrass, but winds generally weaken to the east and north.

For most of the Mixedgrass Natural Subregion, mean annual precipitation ranges from 336 to 428 mm, mean daily temperature ranges from 3.8 to 6.4 °C, and degree days above 5°C range from 1541 to 1789. The mean daily temperature is above 5 °C between April 14 and October 27 in Lethbridge, based on a 30-year average (Chetner 2003). The Cypress Hills station, which occurs at a higher elevation, is cooler and much moister than other stations in the Mixedgrass, with a mean daily temperature of 3.1°C, only 1269 degree days >5°C, and a mean annual precipitation of 607 mm (Table 2). The frost-free period in the Mixedgrass generally ranges from 116 to 129 days (Kjearsgaard et al. 1986), compared with only 52 days in the Upper Cypress Hills (SERM 1998).

Soil temperatures were monitored monthly to twice monthly over a four-year period at two stations in the Mixedgrass Natural Subregion, and one station in the Foothills Fescue on the Milk River Ridge (Kjearsgaard et al. 1984). Soil temperatures were monitored over a 30-year period at the Lethbridge Research Station (Environment Canada 2002). Soil temperatures on the Mixedgrass Highlands and the Mixedgrass Plains were generally warmer than temperatures on the Milk River Ridge to a depth of at least 100 cm (Table 3), reflecting the colder temperatures at higher elevations. The exception to the above generalization is that winter soil temperatures on the Milk River Ridge were warmer than those on the Mixedgrass Plains, even though the Milk River Ridge station occurs at a much higher elevation (Table 3). Winter soil temperatures on the Milk River Ridge are insulated by snow, which is much more permanent throughout the winter, compared with on the Mixedgrass Plains.

Table 2. Summary of climatic data for selected stations in the Mixedgrass Natural Subregion.

[Z]Ecodistrict	Station	Elev-ation (m)	Mean Daily Temp. (°C)	Total precip. (P) (mm)	Mean precip. as rain (%)	% of ppt. from May to Sept.	[Y](P-PE) (mm)	Degree Days > 5°C
Cypress Hills	Saskatchewan (49°40'N, 109 °28'W)	1196	3.1	606.8	57.4	52.0		1269
Sweetgrass Upland	Aden	1036	6.4	406.9	69.5	59.8		
Lethbridge Plain	Claresholm	1008	5.2	428.2	71.2	62.7		1626
	Lethbridge Research St.	921	5.8	365.0	69.3	60.6	-338.8	1789
	Lethbridge Airport	929	5.7	386.3	70.2	62.8		1772
	Carmangay	939		397.6	69.6	64.5		
	Ft. Macleod	950	5.7	425.0	69.3	60.6		1737
Vulcan Plain	Vulcan	1049	4.6	415.3	71.2	66.0		1596
Blackfoot Plain	Gleichen	905	3.8	336.3	78.4	70.6		1541
	Queenstown	940	4.6	416.2	68.0	61.7		1629

Data presented are Canadian Climate Normals for the 1971 – 2000 period (From www.msc-smc.ec.gc.ca/climate/climate_normals/results

[Z]No climate stations are located in the Milk River Upland, the Majorville Upland or the Standard Plain Ecodistricts.

[Y] Precipitation – Potential Evapotranspiration

Table 3. Soil temperatures in the Mixedgrass Natural Subregion, compared to the Foothills Fescue.

Month	Natural Subregion, with Elevation	Soil Temperature at Depth (cm)			
		10	20	50	100
January	[Z]Foothills Fescue, 1285 m	-2.0	-1.7	0.0	0.9
	[Z]Mixedgrass, Milk River Ridge, 1210 m	-1.0	-1.0	0.7	2.3
	[Z]Mixedgrass Plains, Ridge Reservoir, 990 m	-3.3	-1.9	-1.3	2.8
	[Y]Mixedgrass Plains, Lethbridge, 921 m	-2.9	-2.3	-0.7	2.3
July	[Z]Foothills Fescue, 1285 m	14.8	12.8	11.4	8.2
	[Z]Mixedgrass, Milk River Ridge, 1210 m	17.4	13.9	12.0	10.1
	[Z]Mixedgrass Plains, Ridge Reservoir, 990 m	20.8	18.3	15.0	12.8
	[Y]Mixedgrass Plains, Lethbridge, 921 m	22.9	20.3	18.8	14.8
Annual	[Z]Foothills Fescue, 1285 m	5.5	4.9	5.2	4.2
	[Z]Mixedgrass, Milk River Ridge, 1210 m	7.1	5.7	6.1	6.1
	[Z]Mixedgrass Plains, Ridge Reservoir, 990 m	7.1	7.3	6.8	8.0
	[Y]Mixedgrass Plains, Lethbridge, 921 m	9.1	8.2	8.4	8.2

[Z]Kjearsgaard et al. 1986. [Y]Environment Canada 2002.

2.2 Correlation of Soils and Range Sites

The major soil series and their associated range sites for each ecodistrict in the Mixedgrass Natural Subregion are summarized in Table 4. LandWise Inc. (1998, 2001, 2003) has developed soil correlation guidelines to link soils and site to range site types. A complete listing of range site types can be found in Appendix 9.1.

- Soil correlation guidelines to range sites for SCA 2 and 3 can be found in Tables 5 and 6 in the following pages. You can use AGRASID 3.0 or a published soil survey report to determine the dominant and subdominant soils for the site you wish to evaluate. Use the soil series name or three letter name abbreviation to determine range site.
- Range site can also be determined using the Range Site descriptions in section 2.3 on page 16.
- **See Appendix 9.2 A Concise Guide to Assist Users of AGRASID**

Major Soil Orders and Great Groups in the Mixedgrass Natural Subregion:

Soil Orders and Great Groups

Dark Brown Chernozemic soils dominate in the Mixedgrass Natural Subregion, as opposed to Black Chernozems in the Foothills Fescue Natural Subregion,and Brown Chernozems in the Dry Mixedgrass Natural Subregion (Table 1). Chernozemic soils are well- to imperfectly-drained soils that have developed under grassland communities. They are characterized by a dark-colored surface (A) horizon that is about 10 to 15 cm thick, resulting from the accumulation of debris from the accumulation and decomposition of organic matter derived from grasses and forbs. The A horizon of Dark Brown Chernozems has a color value darker than 3.5 moist and 3.5-4.5 dry. Chroma is usually greater than 1.5 dry. Free lime is generally leached to 50 cm or less. The soil climate is cold, rarely mild, and semiarid.

Regolsolic soils occur to a minor extent. Regosols lack a B horizon, and may also be characterized by a shallow A horizon. Regosols are weakly developed soils for many reasons, which can include development on young geologic materials (floodplains or sand dunes), or in unstable locations, such as steep slopes, active floodplains or locations prone to wind erosion.

Solonetzic soils contain a high proportion of sodium in the subsoil and they are characterized by a hardpan layer in the subsoil that is massive and hard when dry, and impervious and very sticky when wet. They are usually associated with areas of former saline and sodic groundwater discharge, but they can also occur where sodium-rich bedrock material occurs at or near the soil surface. Solonetzic soils occur infrequently in the Mixedgrass Natural Subregion, although they are common in the Lower Cypress Hills.

Gleysols are subject to periodic flooding or prolonged wetting, and typically lack oxygen during a portion, or most, of the growing season. Gleysols are often nutrient-poor due to denitrification, and because decomposition is hindered by wetness. Gleysols are associated with wetlands enriched by either groundwater discharge or surface-water collection.

The major soil series and their associated ecological/range sites for each ecodistrict in the Mixedgrass Natural Subregion are summarized in Table 4.

Table 4. Major soils and associated ecological/range sites, by Ecodistrict or area.

Ecodistrict or Sub-Ecodistrict	Major Soil Series	Soil Subgroup	Parent Material	Ecological/Range Site
Upper Cypress Hills (>1110m)	DMS (Delmas)	Orthic Dark Brown Chernozemic	gravelly very coarse fluvial	Loamy (Lo) and Gravel (Gr)
	MCA (McAlpine)	Dark Brown Solodized Solonetz	glacial till	Blowouts (BlO)
	MMK (Marmaduke)	Orthic Dark Brown Chernozemic	medium fluvial veneer over gravelly very coarse fluvial	Loamy (Lo)
	PME (Plume)	Rego Dark Brown Chernozemic	glacial till	Limy (Li)
	WSM (Wisdom)	Orthic Dark Brown Chernozemic	glacial till	Loamy (Lo)
Lower Cypress Hills (1025-1110m)	CGW (Craigower)	Dark Brown Solodized Solonetz	moderately fine glaciolacustrine	Blowouts (BlO) and Overflow (Ov)
	GNN (Glenbanner)	Orthic Dark Brown Chernozemic	moderately fine glaciolacustrine	Overflow (Ov) and Loamy (Lo)
	MNA (Minda)	Dark Brown Solodized Solonetz	glacial till over fine residual	Blowouts (BlO) or Thin Breaks (TB)
	TTH (Tothill)	Orthic Dark Brown Chernozemic	glacial till	Loamy (Lo)
	WCR (Woolchester)	Rego Dark Brown Chernozemic	glacial till	Limy (Li)
Sweetgrass Upland	LUP (Lupen)	Orthic Dark Brown Chernozemic	medium glaciolacustrine over glacial till	Loamy (Lo)
	MNA (Minda)	Dark Brown Solodized Solonetz	glacial till over fine residual	Blowouts (BlO) or Thin Breaks (TB)
	PLP (Philp)	Orthic Dark Brown Chernozemic	glacial till over medium residual	Loamy (Lo)
	PUR (Purescape)	Orthic Dark Brown Chernozemic	glacial till	Loamy (Lo)
	SOL (Sprole)	Orthic Dark Brown Chernozemic	glacial till	Loamy (Lo)
	WID (Wilda)	Rego Dark Brown Chernozemic	glacial till	Limy (Li)
Milk River Upland	GRG (Grudge)	Dark Brown Solodized Solonetz	glacial till	Blowouts (BlO)
	KSR (Kessler)	Orthic Dark Brown Chernozemic	moderately coarse fluvial	Sandy (Sy)
	LUP (Lupen)	Orthic Dark Brown Chernozemic	medium glaciolacustrine over glacial till	Loamy (Lo)
	PUR (Purescape)	Orthic Dark Brown Chernozemic	glacial till	Loamy (Lo)
	VEB (Verburg)	Rego Dark Brown Chernozemic	glacial till	Limy (Li)
	WID (Wilda)	Rego Dark Brown Chernozemic	glacial till	Limy (Li)
Lethbridge Plain	BKE (Brocket)	Rego Dark Brown Chernozemic	fine glaciolacustrine	Limy (Li)
	CLD (Coaldale)	Orthic Dark Brown Chernozemic	fine glaciolacustrine	Clayey (Cy)

Ecodistrict or Sub-Ecodistrict	Major Soil Series	Soil Subgroup	Parent Material	Ecological/Range Site
	CMY (Carmangay)	Orthic Dark Brown Chernozemic	moderately coarse glaciofluvial over moderately fine glaciolacustrine	Sandy (Sy)
	CRD (Cradduck)	Orthic Dark Brown Chernozemic	glacial till	Loamy (Lo)
	KSR (Kessler)	Orthic Dark Brown Chernozemic	moderately coarse glaciofluvial	Sandy (Sy)
	LET (Lethbridge)	Orthic Dark Brown Chernozemic	medium glaciolacustrine	Loamy (Lo)
	RDM (Readymade)	Orthic Dark Brown Chernozemic	glacial till	Loamy (Lo)
	WNY (Whitney)	Orthic Dark Brown Chernozemic	medium glaciolacustrine over glacial till	Loamy (Lo)
Vulcan Plain	KCH (Kirkchamp)	Solonetzic Dark Brown Chernozemic	moderately fine glaciolacustrine	Loamy (Lo)
	PUY (Pulteney)	Orthic Dark Brown Chernozemic	glacial till	Loamy (Lo)
	RDM (Readymade)	Orthic Dark Brown Chernozemic	glacial till	Loamy (Lo)
	WNY (Whitney)	Orthic Dark Brown Chernozemic	medium glaciolacustrine over glacial till	Loamy (Lo)
Blackfoot Plain	CIO (Chokio)	Calcareous Dark Brown Chernozemic	moderately fine glaciolacustrine	Limy (Li)
	CMY (Carmangay)	Orthic Dark Brown Chernozemic	moderately coarse glaciofluvial over moderately fine glaciolacustrine	Sandy (Sy)
	KSR (Kessler)	Orthic Dark Brown Chernozemic	moderately coarse fluvial	Sandy (Sy)
	LET (Lethbridge)	Orthic Dark Brown Chernozemic	medium glaciolacustrine	Loamy (Lo)
	WNY (Whitney)	Orthic Dark Brown Chernozemic	medium glaciolacustrine over glacial till	Loamy (Lo)
Majorville Upland	PGT (Pageant)	Solonetzic Dark Brown Chernozemic	medium to moderately fine fluvial over glacial till	Loamy (Lo)
	RDM (Readymade)	Orthic Dark Brown Chernozemic	glacial till	Loamy (Lo)
	WNY (Whitney)	Orthic Dark Brown Chernozemic	medium glaciolacustrine over glacial till	Loamy (Lo)
Standard Plain	CLD (Coaldale)	Orthic Dark Brown Chernozemic	fine glaciolacustrine	Clayey (Cy)
	KHO (Kehol)	Dark Brown Solodized Solonetzic	moderately-fine glaciolacustrine	Loamy (Lo)
	LET (Lethbridge)	Orthic Dark Brown Chernozemic	medium glaciolacustrine	Loamy (Lo)
	RDM (Readymade)	Orthic Dark Brown Chernozemic	glacial till	Loamy (Lo)
	WNY (Whitney)	Orthic Dark Brown Chernozemic	medium glaciolacustrine over glacial till	Loamy (Lo)

Table 5. **SCA2: Dark Brown Highlands of Mixedgrass**
Soil series of soil correlation area (SCA) 2 linked to range sites.

Productivity Rating	Ecological/Range Site	Soil or Landscape Description	[Z]Soil Series
More herbage due to superior soil moisture	Overflow (Ov)	Fan, apron, channeled or concave (non-saline) landscapes	**CGW, GNN**
	Subirrigated (Sb)	Gleyed; imperfectly drained (CSSC 1998)	
	Wetlands (WL)	Gleysols; poorly drained (CSSC 1998)	ZGW
Normal vegetation response	Clayey (Cy)	Fine (FI) or very fine (VF) textures (see Fig. 4.)	HEG, RLK
	Loamy (Lo)	Medium (ME) or moderately fine (MF) textures (see Fig. 4.)	EKW, FOR, **GNN**, LUP, MMD, **PLP**, **PME**, PUR, **RSR**, SOL, **THA**, TTH, WSM
	Sandy (Sy)	Moderately coarse (MC); or very coarse (VC) veneer over medium (ME) textures	LVYaa[Y], MGA, MKRaa
Limited by moisture (or soluble salts adversely affecting plant growth)	Badlands (BdL)	Bedrock exposures >10%, and bedrock generally <1m deep; AGRASID landscape models include I4, I4m, and I5	ZCV
	Blowouts (BlO)	Dominant or co-dominant soils in the Solonetzic order (CSSC 1998)	**CGW**, GRG, MHR, MCA, MNA, ZSZ
	Choppy Sandhills (CS)	Duned landscape models; very coarse (VC) textures (see Fig. 4.)	
	Gravel (Gr)	Gravels at the surface or <30 cm from the surface	DMS, NEDaa, **RSR**
	Limy (Li)	Calcareous or Rego subgroups; or eroded phases (CSSC 1998)	**PME**, WCR, WID, ZER
	Saline Lowlands (SL)	Saline discharge; salt-enriched	ZNA
	Sands (Sa)	Very coarse (VC) and <u>not</u> duned (CSSC 1998)	HRK, KSRaa
	Shallow to Gravel (SwG)	veneer (30 – 100 cm) over gravels	BFTaa, CFTaa, **THA**
	Thin Breaks (TB)	Bedrock generally, 1 - 5 m; bedrock exposures <10%	DPT, **PLP**

[Z]For a complete description of soil series attributes please refer to the Soil Names file in AGRASID 3.0 (www.agric.gov.ab.ca/asic).

[Y] aa: indicates soil series that occur mainly in a bordering SCA, with only a small area in this SCA.

Note: Soil series codes in bold occur in more than one ecological/range site.

Table 6. SCA3: Dark Brown soil zone associated with the plains of the Mixedgrass, soil series of soil correlation area (SCA) 3 linked to ecological range sites.

Productivity Rating	Ecological/Range Site	Soil or Landscape Description	[Z]Soil Series
More herbage due to superior soil moisture	Overflow (Ov)	Fan, apron, channeled or concave (non-saline) landscapes	
	Subirrigated (Sb)	Gleyed; imperfectly drained (CSSC 1998)	
	Wetlands (WL)	Gleysols; poorly drained (CSSC 1998)	MNH, SGY, ZGW
Normal vegetation response	Clayey (Cy)	Fine (FI) or very fine (VF) textures (see Fig. 4.)	CLD, MGT, **WLG**
	Loamy (Lo)	Medium (ME) or moderately fine (MF) textures (see Fig. 4.)	CRD, FOR, FSTaa[Y], KCH, LET, LUP, MGA, OAS, PUR, PGT, PUY, RDM, WNY
	Sandy (Sy)	Moderately coarse (MC); or very coarse (VC) veneer over medium (ME) textures	KSR, CMY, MGRaa
Limited by moisture (or soluble salts adversely affecting plant growth)	Badlands (BdL)	Bedrock exposures >10%, and bedrock generally <1m deep; AGRASID landscape models include I4, I4m, and I5	
	Blowouts (BlO)	Dominant or co-dominant soils in the Solonetzic order (CSSC 1998)	AWD, BFDaa, IMY, KHO, KRK, LSD, PAR, **TLAaa**, ZSZ
	Choppy Sandhills (CS)	Duned landscape models; very coarse (VC) textures (see Fig. 4.)	**HRKaa**
	Gravel (Gr)	Gravels at the surface or <30 cm from the surface	MAC, NED, WOL
	Limy (Li)	Calcareous or Rego subgroups; or eroded phases (CSSC 1998)	BKE, CIO, DIM, MCNaa, NEM, OSN, SXT, VEB, **WLG**, ZER
	Saline Lowlands (SL)	Saline discharge; salt-enriched	ZNA, HSR, KCP, LLD, WTN
	Sands (Sa)	Very coarse (VC) and not duned (CSSC 1998)	**HRKaa**
	Shallow to Gravel (SwG)	veneer (30 – 100 cm) over gravels	CFT
	Thin Breaks (TB)	Bedrock generally, 1 - 5 m; bedrock exposures <10%	MKN, **TLAaa**, VAC

[Z]For a complete description of soil series attributes please refer to the Soil Names file in AGRASID 3.0 (www.agric.gov.ab.ca/asic).

[Y] aa: indicates soil series that occur mainly in a bordering SCA, with only a small area in this SCA.

Note: Soil series codes in bold occur in more than one ecological/range site.

2.3 Procedure for Determining Range Sites

Range sites are divided into three groups based on their main defining feature of landscape, soil or texture.

Group 1 - Range Sites Defined Mainly by Landscape

Badlands/Bedrock (BdL):

Applies to all inclined to steeply sloping landscapes with greater than 10% bedrock exposures of softrock or hardrock. Slopes generally range from 15% to 60% (in isolated cases 7% to 100%). Includes I4m, I4h and I5 landscape models from AGRASID 3.0.

Overflow (Ov):

Applies to non-saline Chernozemic (soils with A, B and C horizons) and/or Regosolic soils (soils that lack a B horizon >5 cm thick, and may lack an A horizon) on landscapes that are low-relief inclines in valley or basinal settings. Overflow sites are usually fan or apron deposits, where upslope streams enter lowland areas and experience a marked decrease in gradient. Slopes generally range from 2% to 9% (in isolated cases from 0.5% to 15%). Overflow occurs only on lower slope positions or adjacent to stream(s), and the percentage of eligible overflow ranges from 10% to 50% per SLM (specific rules within each SCA). Ov includes I3l and I4l landscape models from AGRASID 3.0, and also applies to the soil series Glenbanner (GNN) and lowland areas of hummocky landscapes in SCA2.

Riparian (Ri):

Applies to all stream channels and floodplains. Includes FP1, FP2, FP3, SC1-l, SC1-h, SC2, SC3 and SC4 landscape models from AGRASID 3.0. True riparian areas only include the valley floor (from bottom of bank to bottom of bank on the other side of the valley).

Thin Breaks (TB):

Applies to: 1) all steeply-sloping landscapes with less than 10% bedrock exposures; 2) largely vegetated areas with bedrock at or near (within 5 m of) the surface; 3) the soil series Dempster (DPT), Mokowan (MKN), Torlea (TLAaa), and Van Cleeve (VAC) and 4) AGRASID 3.0 landscape models I3m, I3h or I4m.

Group 2 - Range Sites Defined Mainly by Soil Features

Blowouts (BlO):

Applies to all SLMs where soils from the Solonetzic order are dominant (>50%) or co-dominant (30 to 50%). Solonetzic soils have an impervious hardpan layer (Bnt horizon) in the subsoil that is caused by excess sodium (Na+). The land surface is frequently characterized by eroded pits. Applies to the soil series Arrowwood (AWD), Brownfield (BFDaa), Craigower (CGW), Grudge (GRG), Idamay (IMY), Kehol (KHO),

Kirkcaldy (KRK), Lakesend (LSD), MacAlpine (MCA), Maher (MHR), Minda (MNA), and Parr (PAR), and also applies to undifferentiated Solonetz (ZSZ).

Limy (Li):

Applies to all immature or eroded soils with free lime (calcium carbonates) at the soil surface or in the B horizon. Free lime is detected by effervescence when soil is treated with 10% hydrochloric acid (HCl). Li soils include Rego or Calcareous Chernozemics, eroded phases, and subgroups from the Regosolic order if they are calcareous. Applies to the soil series Brocket (BKE), Chokio (CIO), Diamond (DIM), McNab (MCNaa), NineMile (NEM), Olsen (OSN), Sexton (SXT), Verburg (VEB), Welling (WLG), Woolchester (WCR), Wilda (WID) and for ZER if not on I3l, I3h, I4m or I4h landscapes.

Sub-irrigated (Sb):

Applies to all Gleyed, non-saline, medium to very coarse textured soils. Gleyed soils occur where the water table occurs near the soil surface, but does not often occur above the soil surface. Gleyed subgroups have faint to distinct mottles within 50 cm, or prominent mottles between 50 and 100 cm.

Saline Lowland (SL):

Applies to all salt-enriched soils, including Saline phase Chernozemic, Saline phase Regosolic, and Saline phase Gleysolic soils. Saline phase soils have an electrical conductivity greater than 4.0 dS/m, which retards most plant growth. Applies to the soil series Hussar (HSR), Kyiscap (KCP), Lilydale (LLD), and Weston (WTN), and also applies to undifferentiated saline soils (ZNA).

Wetlands (WL):

Applies to all non-saline or weakly-saline of the Gleysolic and Organic orders. Gleysolic soils occur in seasonal to semi-permanent wetlands. They are typified by dull colours or prominent mottles with 50 cm, due to prolonged periods of intermittent or continuous saturation, and the lack of oxygen in the soil. Organic soils are dominated by the accumulation of decomposing peat material derived mainly from sedges and reeds. Applies to the Gleysolic soil series Monarch (MNH) and Sloughay (SLY), and also applies to undifferentiated wet soils (ZGW).

Group 3 - Range Sites Defined Mainly by Textural Groupings

Soils are made up of varying components of sand, silt and clay, with the sum of the three equal to 100% (Fig. 4). Soils may also include particles larger than 2.0 mm, or coarse fragments (Table 7).

Table 7. **Definition of soil particle sizes.**

Category	Particle	Diameter (mm)
Components of soil texture	clay	<0.002
	silt	0.002 to 0.05
	sand	0.05 to 2
Coarse fragments	gravel	2 to 75
	cobbles	75 to 250
	stones	250 to 600
	boulders	>600

Clayey (Cy):

Applies to all non-saline and non-gleyed Chernozemic soils (soils with A, B and C horizons), and non-saline and non-gleyed Regosolic soils (soils that lack a B horizon >5 cm, and may lack an A horizon) with soil textures in the fine or very fine (E.g., clay and silty clay) textural subgroups (>40% clay, Fig. 4.). Applies to the soil series Cardston (CTN), Pincher (PNR), Shandor (SND), Three Hills (THH), and Twining (TWG).

Loamy (Lo):

Applies to all non-saline and non-gleyed Chernozemic soils (soils with A, B and C horizons), and non-saline and non-gleyed Regosolic soils (soils that lack a B horizon >5 cm, and may lack an A horizon) with soil textures in the medium and moderately fine textural subgroups (E.g., loam and clay loam, Fig. 4.). Applies to the soil series Academy (ADY), Bullhorn (BUL), Beazer (BZR), Delacour (DEL), Del Bonita (DLB), Hillmer (HLM), Lyalta (LTA), Rockyview (RKV), Sakalo (SAK), and Standoff (SOF).

Sandy (Sy):

Applies to all non-saline and non-gleyed Chernozemic soils (soils with A, B and C horizons), and non-saline and non-gleyed Regosolic soils (soils that lack a B horizon >5 cm, and may lack an A horizon) with soil textures in the moderately coarse (sandy loam) textural subgroup. Applies to the soil series Knight (KNT), Lonely Valley (LVY), and Midnapore (MDP).

Sands (Sa):

Applies to all non-saline and non-gleyed Chernozemic soils (soils with A, B and C horizons), and non-saline and non-gleyed Regosolic soils (soils that lack a B horizon >5 cm, and may lack an A horizon) with soil textures in the very coarse (loamy sand) textural subgroup. Sa does not apply to duned landscapes. Applies to the soil series Ardenode (ARE) and Highwood (HIW).

Choppy Sandhills (CS):

Applies to all non-saline and non-gleyed Chernozemic soils (soils with A, B and C horizons), and non-saline and non-gleyed Regosolic soils (soils that lack a B horizon >5

cm, and may lack an A horizon) with soil textures in the very coarse (loamy sand) textural subgroup. CS applies to soils that occur on duned landscapes, including D1l, D1m, D1h, D2l, D2m and D2h in AGRASID 3.0. Applies to the soil series Ardenode (ARE).

Gravel (Gr):

Applies to any soil with less than 20 cm of a surface mantle of any textural class over very gravelly or very cobbly (>50% gravel or cobbles) material. Applies to the Rinard (RND) and Bow Valley (BOV) soil series.

Shallow-to-Gravel (SwG):

Applies to any soil with 20 to 50 cm of a surface mantle of any textural class overlying gravelly or very gravelly or cobbley to very cobbley (>20% gravel or cobbles) material. Applies to the Blackfoot (BFT), Rockford (RFD) and Rosebud (RSB) soil series.

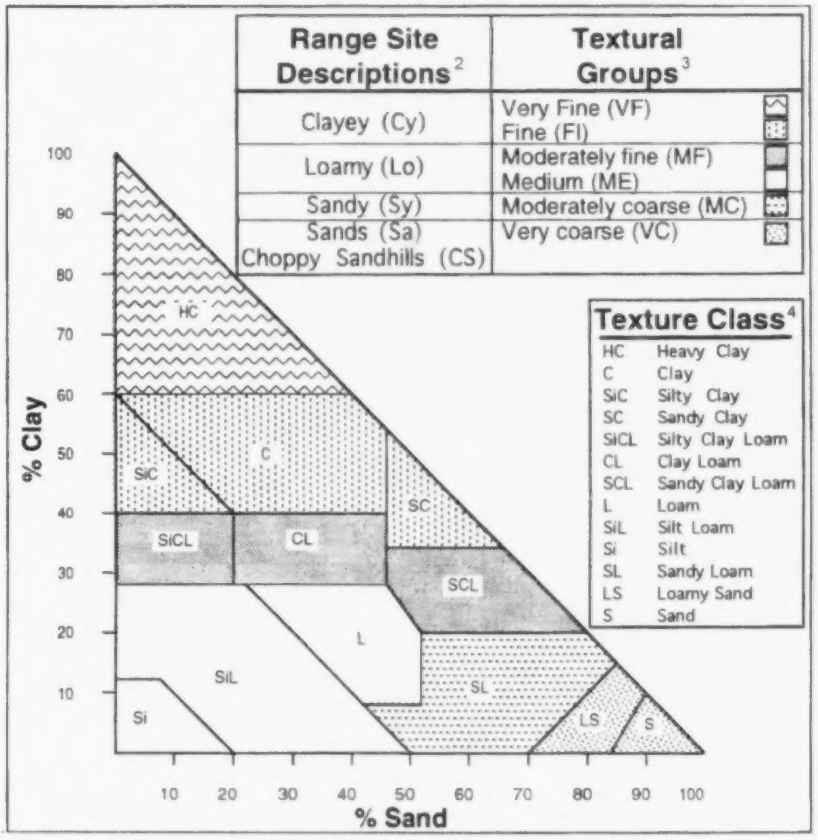

Fig. 4 Soil textures and their relationship to ecological range sites.

3.0 Review of Grazing Research in the Mixedgrass Natural Subregion

Why is plant community important?

Ranchers and range resource managers generally strive to maintain plant communities at or near the climax or potential natural community(PNC) stage because this stage provides higher levels of ecological functioning. Healthy range plant communities are said to perform important ecological functions and to provide a broader suite of goods and services than lower seral stages. A rich history of grazing research has taken place in the Dry Mixedgrass prairie at Agriculture and Agri-Food Canada research substation at Onefour, where range management research was initiated in 1927. The Dominion Experimental Farms Service established the first rangeland research program in Canada at Onefour, near Manyberries Alberta. The research program provided the first scientifically based guidelines on stocking rates and range management practices in the country. Range management research has been continuous at the site and is ongoing. Although Onefour is located in the brown soil zone, much of the research has relevance to grazing management consideration in the dark brown soil zone of the Mixedgrass Natural Subregion.

Ecological Status of the Mixedgrass Prairie

Prior to the 1980's, the brown soil zone in Alberta was first described as "short grass" prairie, implying an ecological link to the short grass steppe of interior plains and a dominance of warm season species like blue grama grass. The ecological literature strongly supports the historical profile of grazing impacts outlined in this chapter. There is considerable evidence that the mixedgrass prairie experienced heavy livestock grazing during the early decades of the 20th century (Adams et al 2004). Government policies that promoted unsustainable stocking rates, a lack of knowledge about sustainable grazing practices, ranges that were fully stocked by the end of WWI, a reliance on horses to power prairie plows and drought all contributed to very heavy overgrazing of prairie rangelands by the time of the Great Depression . Heavy grazing during the early decades established a broad landscape level of impact on grassland plant communities that was recognized by early plant ecologists. When Coupland (1961) reflected on the works of Clark et al. (1942) and Hubbard (1950), and then on his own initial plant community studies (Coupland 1950), he concluded that the use of the term "short-grass" prairie was a misnomer. He observed that early studies that defined blue grama-dominated communities were carried out after a period of poor moisture conditions and the abundance of needle-and-thread grass had been reduced by grazing pressure, much more so than early investigations had recognized.

Since that time, with improved policy, range management practices and knowledge and climatic conditions, the Mixedgrass character of the brown and dark brown soil zones has been re-established as mid-grasses like needle-and-thread, porcupine grass, northern and western wheatgrass have become far more abundant on the landscape, establishing dominance on almost all range sites over the decumbent, low-growing, grazing-resistant blue grama.

Long-Term Stocking Rates Study

At Onefour, in the Dry Mixedgrass Natural Subregion, a nineteen-year study (Smoliak et al. 1972) compared three rates of stocking with sheep: **light,** 6.2 ac/AUM; **moderate**, 5.0 ac/AUM; and **heavy**, 4.2 ac/AUM. As grazing pressure increased, the deep-rooted grasses, such as needle-and-thread and northern and western wheatgrass, were replaced by shallow rooted and grazing resistant species like blue grama, low sedge and little club moss. Soil responses with increased stocking included a decline in deep-rooting plants (45 to 60 cm depth) and an increase in shallow-rooting plants (0 to 15 cm depth) and lower values for total carbon and its various components. Previous work (Clark et al. 1947) detected a significant decline in range condition on the mixed prairie, with as little as five years of heavy grazing.

A paradox exists between the fescue and mixedgrass prairies in terms of the impact of prolonged heavy grazing. While many similar changes occur in terms of plant species shifts from tall deep-rooted species to low, shallow-rooted species, the degree of impact to soil is different. While the black soils of the foothills fescue are seriously degraded under very heavy grazing most loamy mixedgrass soils remain relatively stable. An increased cover of blue grama grass and little club moss may help protect the soil surface from accelerated erosion and loss of valuable topsoil. There are no long-term studies that document soil and vegetation responses on choppy sandhill or blowout range sites in the mixedgrass prairie, where site/soil instability would likely be greater with heavy grazing pressure.

Grazing Impacts on Soils and Watershed Function

Heavy grazing can change the plant/soil micro-environment of the mixedgrass prairie as plant biomass is depleted from the soil surface (Whitman 1974). Changes include increased surface and subsoil temperatures and increased wind speeds at the soil surface, producing more severe evaporative conditions. At Onefour, removal of standing dead plant material over three successive years reduced forage yields to 40% of the control (Willms et al. 1986). Litter residue (mulch) is particularly vital in the mixedgrass prairie to reduce soil temperatures and to conserve scarce moisture. Early studies at Onefour recognized that either spring or fall burning reduced the herbage yield on mixedgrass prairie for a period of 3 to 5 years (Clark et al. 1943).

The principle range management strategy for improving water-use efficiency in this semi-arid environment (Willms and Jefferson 1993) has two elements, first to promote plant species that are deep rooted and complete their growth before the summer drought and second, to manage grazing intensity to allow for the maintenance of adequate litter levels to enhance the utilization of scarce moisture.

Grazing Versus Protection

A recent study in Grassland National Park showed that protection from grazing for 7 to 17 years produced only modest impacts to structure and composition of mixedgrass prairie vegetation (Thorpe and Godwin 2003). On alluvial flats dominated by silver sagebrush, protected sites had higher vertical cover of grasses and shrubs. However, forb richness was significantly lower in ungrazed areas, a vegetation component of value to

wildlife species like Sage-Grouse and Pronghorn.

It appears the impacts of grazing versus protection may differ by soil type. At Onefour, after seventy years of protection, ungrazed loamy range sites showed a higher proportion of northern and western wheatgrass and higher forage productivity (Willms et al. 2002). In the same study, the effect of long-term rest was neutral on blowout range sites where vegetation canopy cover is lower and the potential for litter accumulation is limited by solonetzic soil conditions. Plant community characteristics and productivity were similar between grazed and protected areas.

Blue grama grass is able to withstand heavy grazing pressure because its short stature allows it to avoid grazing impact and it is better able to compete in dry environments (Weaver and Albertson 1956). Dormaar and Willms (1990) noted that previously heavily grazed mixedgrass prairie was still dominated by blue grama after 19 years of rest. However, in the Onefour study (Willms et al. 2002), overall range condition improved over a 70 year time frame. After 70 years, the cover of blue grama grass declined from about 55% in 1929 as determined by basal area (Clarke et al.1947) to about 8 and 21% as determined by canopy cover on protected and grazed treatments, respectively. The high proportion of blue grama in 1929 was thought to be indicative of previous heavy grazing and drought as described earlier.

Recovery of Mixedgrass Prairie Following Cultivation and Abandonment

Several million acres of Mixedgrass Prairie were cultivated and abandoned in Alberta in the early decades of the 20th century (D. Major, personal communication). Coupland (1961) observed that the rate of plant community succession back to native mixedgrass prairie cover would depend on the size of the cultivated area, the distance to the supply of native seed stock, the degree of aridity of the years following abandonment and the length of time that tillage took place prior to abandonment. Succession back to a community dominated by mid-grasses tended to be first through native and introduced annual forbs, then to native perennial forbs and finally perennial grasses. Western wheatgrass was one of the first of the mid-grasses to reestablish. Under the most favorable of conditions, a late-seral community might develop within 20 years.

Recovery studies of abandoned cultivation (AC) near Lethbridge support this view. A pasture with dark brown chernozemic soils, that had been cultivated in the autumn of 1928 and abandoned by the spring of 1932, reverted to a needle-and-thread community. An exclosure built in 1978, spanning the AC and the original prairie unbroken prairie, showed a differential path to recovery. By 1992, the AC had a canopy cover dominated by needle-and-thread (79%) and fringed sage (6%), while on the uncultivated side of the exclosure, the community was dominated by blue grama (51%) and needle-and-thread (18%). Again, blue grama grass has a competitive advantage with heavy grazing pressure (Smoliak 1974). Even with 14 years of rest, dominance of blue grama persisted. Cultivation and abandonment allowed needle-and-thread to regain dominance while blue grama persisted on the unbroken land.

Recovery of soil quality on AC takes much longer than vegetation. Dormaar et al.(1990) evaluated a number of soil quality factors on sites previously cultivated and abandoned in 1925, 1927, 1950 and 1975 and then grazed during the recovery process at moderate, and

they predicted that it would take at least 70 years to restore the quality of soil organic matter found in native Mixedgrass Prairie soils.

Table 8 provides a summary of the functions and values associated with healthy Mixedgrass Prairie plant communities and background rational as to why it is important to manage for a high standard of rangeland health.

Table 8. Functions and characteristics of healthy Mixedgrass plant communities.

Functions and Characteristics of Mixedgrass Communities	Why are healthy plant communities important? Impact of excessive disturbance on values and functions.
Forage Productivity	• Forage production is highest from late-seral to climax plant communities. • Forage yield potential declines with loss of mid-grasses like needle-and-thread, western porcupine grass, northern and western wheatgrass.
• **Production Stability and Risk**	• Forage yields are more stable at late-seral to climax stages with adequate litter residue to cool the soil and make scarce moisture more effective. • As species shift to lower seral communities, forage yields fluctuate more and are more dependent on current precipitation conditions.
• **Managerial Efficiency and Flexibility**	• Most late-seral native grasses have higher curability than early seral species (e.g. June grass, Sandberg bluegrass) and provide better late season grazing., reducing wintering costs and making grazing options more flexible for the producer. • Lower successional communities are subject to greater forage weathering losses and declines in forage quality and are unsuitable for winter grazing.
• **Site Stability and Soil Maintenance**	• Mixedgrass plant communities vary in their normal site stability, but most normally have little exposed soil and are stable; as soil exposure exceeds about 10 to 15%, soil loss increases.
• **Moisture Retention and Watershed Function**	• Mixedgrass plant communities produce substantial litter that serves to conserve scarce moisture, enhance moisture infiltration and retention. • Adequate litter residue is critical to moisture conservation and to make scarce moisture more effective. Half the normal forage yield in an average year can be attributed to having adequate litter residue. Litter depletion from heavy grazing may impose a "man caused" drought.
• **Plant Community Structure**	• Mixedgrass plant communities should normally have a high proportion of mid-grasses and provide a taller plant community structure than observed in the Dry Mixedgrass prairie. • Plant community structure declines towards lower seral communities.
• **Wildlife Habitat Values**	• Grazing management can be manipulated to alter the structural characteristics of Mixedgrass prairie by influencing the patch or structural diversity.
• **Biodiversity Maintenance**	• Highest species richness at light to moderate levels of grazing. • Ungrazed Mixedgrass plant communities have simpler species composition with litter build up. • Heavy to very heavy grazing leads to species impoverishment. • Invasion by agronomic species leads to serious decline in plant species diversity.

4.0 Previous Plant Community Studies

4.1 Native Plant Communities

Much of our understanding of the Mixedgrass prairie has been provided by Coupland (1950, 1961 and 1973) and only the description of plant communities on dark brown soils of the Mixedgrass Natural Subregion are reported here. Coupland (1961) described the *Stipa-Agropyron* community type as one of the most common in the Mixedgrass Prairie, being very common on medium textured soils of the dark brown soil zone as well as the more productive upland sites of the brown soil zone. Though this community remains in relatively small parcels today, it was once of the most extensive Mixedgrass Prairie community prior to European settlement, but has been largely converted to cropland (Coupland 1973). With increased precipitation levels and cooler summer growing conditions, mid-grasses are more common. This grassland has a much taller stature than any grassland communities in the Dry Mixedgrass, with four mid-grasses including needle-and-thread, western porcupine grass, western wheatgrass, northern wheatgrass and green needle grass. Combined, these species provide over 65% of the forage yield (Coupland 1973). Blue grama grass is part of this community but normally occurs at 1 or 2 % cover. Where abundant, it is an indicator of past heavy grazing pressure.

In drier environments, such as south facing slopes, upper slopes and knoll tops, the *Stipa-Bouteloua-Agropyron* community becomes dominant. Needle-and-thread grass and blue grama grass are more common and the cover of the other mid-grasses declines (Coupland 1973). Like blue grama, June grass and low sedges are important interstitial species that may become more common with heavy grazing pressure and/or on sites with soil limitations like thin breaks.

An important transitional community of the Mixedgrass that Coupland (1961) identified was the *Festuca- Stipa* type on dark brown soils on the slopes of the Cypress Hills. This community is dominated by plains rough fescue and western porcupine grass and is very similar to the dominant modal grasslands of the Northern Fescue Natural Subregion.

Another important transitional community type is Idaho fescue-northern wheatgrass that has been identified previously by the author (Comer et al. 1999) which may be an example of a plant community that results from the interface between the Pacific Northwest bunchgrass and the Great Plains grasslands (Tisdale 1982). Mueggler and Stewart (1980) describe this as a plains/mountains transition type.

4.2 Modified Plant Communities

There is growing awareness and concern about the impact of invasive agronomic grasses on native plant communities. Research in the past 20 years has raised particular concern about the use of crested wheatgrass as a seeded tame forage species. Crested wheatgrass has had considerable value in facilitating complementary grazing of tame and native forages by permitting spring deferral of grazing on native range thus promoting the full growth potential of the native pasture. However, a number of studies raise serious questions about the long-term sustainability of Mixedgrass Prairie soils when seeded to tame forage species like crested wheatgrass and Russian wildrye. Seeded species do not support the same soil environment as native species and soil quality tends to decline over time (Willms and Jefferson 1993). A variety of soil related impacts have been reported.

Crested wheatgrass releases less carbon into the rhizosphere than do native species like western wheatgrass and blue grama (Biondini et al. 1988). When compared to adjoining native rangeland, 23 year old seedings of crested wheatgrass and Russian wildrye had lower levels of soil organic matter, lower pH and lower root mass (Smoliak and Dormaar 1985). Similar results were reported for seeded sites of crested wheatgrass or Russian wildrye with wide row spacings (55 to 75 cm) which had been established for 20 to 25 years (Dormaar et al. 1994). Conversion of native prairie to tame species resulted in lower physical stability of the soil by decreasing root mass and organic matter.

The concern about crested wheatgrass goes far beyond its impact on seeded sites. Crested wheatgrass invasion of grassland communities has become widespread (Bradley et al. 2003). Henderson and Naeth (2004) have documented the reduction in community and landscape levels of diversity with crested wheat invasion. While major soil properties appeared unchanged, cool season mid-grasses and forbs were lower in abundance following invasion. Crested wheatgrass appears to invade through abundant seed production and more aggressive use of soil moisture in contrast to native species (Henderson and Naeth 2004).

Analysis of plot data from the Grassland Natural Region reveals the presence of invasive agronomics in trace amounts. Kentucky bluegrass was present in 32% of plots, followed by awnless brome at 6%, crested wheatgrass at 4% and Timothy at 2%. The presence of these species in native vegetation may increase the risk of further invasion following soil disturbance by various land use practices as well as from overgrazing.

Table 9 **Percent frequency[1] of invasive agronomic grasses in range vegetation inventory plots within the grassland natural region including the Mixedgrass Natural Subregion.**

Natural Subregion n=sample plots	Timothy	Awnless brome	Kentucky bluegrass	Crested Wheatgrass
Dry Mixedgrass n=1628	0	T	5	2
Mixedgrass n=724	**2**	**6**	**32**	**4**
Foothills Fescue n=283	36	7	68	T
Foothills Parkland n=410	73	21	75	T

[1] Frequency means species are present in plots but does not imply infestation levels of the species in the transect Native Prairie Data Base, Public Lands and Forest Division Division, Alberta Sustainable Resource Development, Lethbridge

5.0 Classification Methods

5.1 Plant Community Classification Methods

Data for this analysis consisted mostly of range survey and rangeland reference area data collected by Alberta Sustainable Resource Development from 1986 until present. A total of 724 vegetation inventory forms were analyzed. All data records were reviewed for completeness, species seven letter codes were assigned along with a unique identifier number for each transect. The data were then entered into the Prairie Data Base (Rangeland Management Branch, Alberta Sustainable Resource Development, Lethbridge). The data base calculates mean values for species composition, total vegetation, moss/lichen and bare soil cover.

The results of vegetation transect queries were extracted from the Prairie Data Base and formatted for analysis in a two dimensional matrix in the *.wk1 format that PC-ORD requires. Ordination and classification studies were carried out on the data sets using PC-ORD (MJM Software, Gleneden Beach, Oregon). The corresponding land data, including soils and site information, were sorted into a corresponding land data matrix.

In order to establish major plant community types ordination and classification interpretations were developed by using two statistical procedures (Willoughby 1997):

a) De-trended Correspondence Analysis was applied (Gauch 1982). This procedure compares similarity and dissimilarity among sites. Plotting of the ordination scores in three dimensional "species space" allows viewing of site and species distributions and facilitates grouping of sites by community types.

b) A cluster analysis procedure was employed as an alternate grouping technique to compare and contrast with the results of the DCA procedure. Ward's method of cluster analysis was the most easily interpreted from the six or more procedures that might be chosen.

Plant community type summaries were generated in Quattro 9 by averaging plant species composition, range in composition and percent constancy of occurrence among groups of vegetation inventory plots considered to form a unique plant community type. Environmental data was subsequently sorted into the same plant community groups as described above for further analysis and correlation with plant community groupings. Total vegetation canopy cover, moss/lichen and bare soil estimates were also calculated for the plant community type groupings of vegetation inventory plots. The resulting plant community descriptions are reported in one page summaries similar to those used by Willoughby et al. (2003).

Ecologically sustainable stocking rates (ESSR) values are suggested for each plant community. These values reflect the maximum number of livestock (e.g.Animal Unit Months (AUM)/acre) that can be supported by the plant community given inherent biophysical constraints and the ecological goal of sustainable health and proper functioning of the plant community. When the ESSR is multiplied by the area (e.g. acres) of a plant community polygon the result is termed **ecologically sustainable carrying capacity (ESCC)**, and is expressed as AUMs. At times, the ESCC must be adjusted for management factors (e.g. reduced livestock distribution), management goals (e.g.

improve rangeland health, multiple use and values, etc.), drought conditions, and other natural phenomena impacting the site (e.g. forage quality, fire, pests, etc.). This adjusted/reduced value is the **ecologically sustainable grazing capacity (ESGC)**. The ESGC values are not provided in the plant community guide because the necessary adjustments are determined by the rangeland resource manager.

Suggested ESSR values may be determined from a combination of forage yield clipping studies, long-term rangeland reference area data, estimated production and historical grazing experience. In order to sustain ecological health and function of the plant community, the ESSR was based on historical grazing rates where the information was available, and on forage yield data when historic grazing records were not available. A number of assumptions underlie the development of ESSRs:

- Ecologically sustainable forage utilization levels are set between 25 % to 50% total herbage production for grassland plant community types and the forage requirements of one animal unit (i.e. 455 kg of dry matter per month).
- The remaining biomass production (carry over), is allocated for the maintenance of ecological functions (e.g. nutrient cycling, viable diverse plant communities, hydrological function, and soil protection, etc.) and plant community services (forage production, habitat maintenance, etc.).
- The allocation of biomass production in this manner is well established and supported by the scientific community, and the amount required varies with Natural Subregion (Holechek et al. 1995).

In this study, the historical grazing records and forage productivity data were correlated in establishing ecologically sustainable stocking rate (ESSR) value through the following steps:

- A ranking was made of major reference plant communities by ecological range site, based on productivity data where available from rangeland reference areas.

- Existing ESSR estimates were correlated with the appropriate range sites from Wroe et al. 1988.

- New carrying capacity data were summarized from grazing records on file for selected grazing dispositions that typify a particular plant community.

- A review team of experienced field staff then reviewed the suggested carrying capacity values and modified carrying capacity estimates where appropriate.

- In the absence of grazing records, and especially with minor plant community types that normally have a small area of occurrence on the landscape, forage yield data or forage yield estimates were applied to derive an ESSR.

6.0 Results and Discussion

The analysis evaluated 724 vegetation plots and distinguished 42 plant communities of which 34 were native grassland or shrub types and eight were modified grassland types. The reference plant communities are listed by ecological range site in Table 10 for all

ecodistricts. The reference plant communities are also grouped with their corresponding successional and modified plant communities by three geographic areas within the Mixedgrass Natural Subregion including Table 11 for the Cypress Upland, Table 12 for the Milk River Upland and Table 13 for Lethbridge, Vulcan and Majorville Plains.

Suggested ecologically sustainable stocking rate values and ranges are provided for the same series of geographic areas in Tables 14, 15 and 16. Each of the 41 plant communities is summarized on pages 38-78. A total of 27 unclassified vegetation plots are summarized in Table 21 of Appendix 1. These plots are unclassified outliers owing to small sample size or unacceptable variability in the ordination eigen values; the plots were not designated as plant communities in this approximation. As additional data become available, these unclassified plots will be reconsidered in future refinements of this guide.

Plant communities were defined for eight range site types including overflow, loamy, sandy, blowout, sands, shallow-to-gravel, thin breaks and saline lowlands. These range sites were further subdivided into 21 ecological range sites, which are an expression of variability within range site types as expressed by unique plant community types (Table 10). For example, the subdivision of Loamy into Loamy 1 to Loamy 7, along with the corresponding plant community names, are subdivisions of the loamy range site based on variability in physiography, climate and soils as expressed by variability in the plant communities. The ecological range site numbers (Loamy 1 to 7 or Blowout 1 to 3) are normally assigned from moistest to driest. Major highlights in terms of reference plant communities include:

- The communities reported here are consistent with Coupland's earlier work (Coupland 1950, 1961, 1973) for much of the Mixedgrass. The climate data reported in Table 2 helps to explain the prominence of plains rough fescue in the Cypress Hills Upland. Data from a Saskatchewan climate station (on slopes of Cypress Hills, below the upper bench) indicates that this ecodistrict likely has the lowest mean temperature, highest precipitation and lowest number of growing degree days within the Mixedgrass Natural Subregion. Therefore, plains rough fescue is able to persist in the cooler, moister environment. In the Milk River Upland, rough fescue occurs on minor landscapes like north facing slopes and is not part of the modal upland cover. This is likely due the warmer and drier growing environment that is intermediate to that of the Cypress Slopes and the balance of the Mixedgrass Natural Subregion that is significantly drier and warmer than the two upland ecodistricts.

- The Cypress Upland is a zone of transition between the Cypress Hills Montane and the Dry Mixedgrass. This progression was marked by three key plant communities including *MGA1 Plains Rough Fescue-Western Porcupine Grass-Sedge* found at middle and upper elevations, *MGA30 Western Porcupine Grass-Northern Wheatgrass-June Grass* and *MGA4 Needle-and-Thread-Northern Wheat Grass-June Grass* found at lower elevations within the ecodistrict.

- The Milk River Upland is also a zone of transition from the Milk River Ridge to the Dry Mixedgrass. This progression was marked by two reference plant communities including *MGA10 Idaho Fescue-Northern Wheat Grass-Needle-and-Thread* at

medium and upper elevations and *MGA14 Needle-and-Thread- Northern Wheat Grass-June Grass* at lower elevations within the ecodistrict.

- In the Lethbridge - Vulcan - Majorville Plains the modal reference plant communities included *MGA21 Wheatgrass-Needle-and-Thread* which closely resembles Couplands (1961) *Stipa-Agropyron* community.

Table 10. Ecological Range Sites and Reference Plant Communities in the Mixedgrass Natural Subregion

Ecological Range Site	Range Plant Community (Reference Plant Community)	Ecodistrict
(Overflow 1)	MGB2 Snowberry/Kentucky Bluegrass-Tufted Hair Grass ***seral***[6]	***Milk River Upland***
(Overflow 2 snow trap)	MGC2 Snowberry/Green Needle Grass-Kentucky Bluegrass ***seral***	***Milk River Upland***
Loamy 1	MGA1 Plains Rough Fescue-Western Porcupine Grass-Sedge	***Cypress Upland***
Loamy 2	MGA10 Idaho Fescue-Northern Wheatgrass-Needle-and-Thread	***Milk River Upland***
Loamy 3	MGA21 Wheatgrass-Needle-and-Thread	***Lethbridge-Vulcan-Majorville Plain***
Loamy 4	MGA30 Western Porcupine Grass-Northern Wheatgrass-June Grass	***Cypress Upland***
Loamy 5 - low elevations	MGA4 Needle-and-Thread-Northern Wheatgrass-June Grass	***Cypress Upland***
Loamy 6 - low elevations	MGA14 Needle-and-Thread- Northern Wheatgrass-June Grass	***Milk River Upland***
Loamy 7	MGC4 Snowberry/Needle-and-Thread-Low Sedge-Northern Wheatgrass ***seral***	***Lethbridge-Vulcan-Majorville Plain***
Sandy 1	MGA16 Needle-and-Thread- Northern Wheatgrass-Sand Grass	***Milk River Upland***
Sandy 2	MGA25 Snowberry/Northern Wheatgrass-Needle-and-Thread	***Lethbridge-Vulcan-Majorville Plain***
Blowout 1	MGA5 Needle and Thread-Plains Rough Fescue-Western Wheat Grass	***Cypress Upland***
Blowout 2	MGA9 Silver Sagebrush/Northern Wheatgrass-June Grass	***Milk River Upland***
Blowout 3	MGA17 Western Wheatgrass-June Grass-Sedge	***Cypress Upland***
Sands 1 Little Bow	MGA28 Snowberry/Needle-and-Thread-Sand Grass-Low Sedge ***seral***	***Lethbridge-Vulcan-Majorville Plain***

[6] In the absence of a recognized Reference Plant Community, the next closest community in terms of ecological status is placed in the reference plant community column and marked as ***seral***.

Ecological Range Site	Range Plant Community (Reference Plant Community)	Ecodistrict
Shallow to Gravel	MGA31 Plains Rough Fescue-Northern Wheatgrass -Western Porcupine Grass	***Cypress Upland***
Gravel	MGA7 Plains Rough Fescue-June Grass-Northern Wheatgrass	***Cypress Upland***
Thin Breaks 1	MGA8 Plains Rough Fescue-Plains Muhly	***Cypress Upland***
Thin Breaks 2	MGA20 Northern Wheatgrass-Needle-and-Thread-June Grass	***Milk River Upland***
(Saline Lowlands 1)	MGA6 Salt Grass-Sedge-Western Wheatgrass	***Cypress Upland***
Saline Lowlands 2	MGA19 Salt Grass-Western Wheatgrass-Sedge	***Milk River Upland***
Saline Lowlands 3	MGA29 Salt Grass-Foxtail Barley-Western Wheatgrass ***seral***	***Lethbridge-Vulcan-Majorville Plain***

Table 11. Plant communities listed by ecological range site within the Mixedgrass Natural Subregion for the Cypress Upland.

Ecological Range Site	Range Plant Community (Reference Plant Community)	Successional Community Types	Modified Plant Communities
(Loamy 1)	MGA1 Plains Rough Fescue-Western Porcupine Grass-Sedge	MGA2 Western Porcupine Grass-Plains Rough Fescue MGA3 Needle-and-Thread-June Grass	MGB1 Crested Wheatgrass-Pasture Sagewort
(Loamy 4)	MGA30 Western Porcupine Grass-Northern Wheatgrass-June Grass		
(Loamy 5 low elevations)	MGA4 Needle-and-Thread-Northern Wheatgrass-June Grass		
(Blowout 1)	MGA5 Needle-and-Thread-Plains Rough Fescue-Western Wheatgrass		
(Blowout 2)	MGA9 Silver Sagebrush/Northern Wheatgrass-June Grass	MGC1 Silver Sagebrush/Western Wheatgrass-June Grass	
(Shallow to Gravel 1)	MGA31 Plains Rough Fescue-Northern Wheatgrass - Western Porcupine Grass		
(Gravel)	MGA7 Plains Rough Fescue-June Grass-Northern Wheatgrass		
(Thin Breaks 1)	MGA8 Plains Rough Fescue-Plains Muhly		
(Saline Lowlands 1)	MGA6 Salt Grass-Sedge-Western Wheatgrass		

Table 12. Plant communities listed by ecological range site within the Mixedgrass Natural Subregion for the Milk River Upland.

Ecological Range Site	Range Plant Community (Reference Plant Community)	Successional Community Types	Modified Plant Communities
(Overflow 1)			MGB2 Snowberry/Kentucky Bluegrass-Tufted Hair Grass
(Overflow 2 snow trap)		MGC2 Snowberry/Green Needle Grass-Kentucky Bluegrass	
(Loamy 2)	MGA10 Idaho Fescue-Northern Wheatgrass-Needle-and-Thread	MGA11 Idaho Fescue-Lupine MGA12 Snowberry/Kentucky Bluegrass-Idaho Fescue MGA13 Canada Bluegrass-Silky Perennial Lupine	MGB3 Awnless Brome-Alfalfa-Kentucky Bluegrass
(Loamy 6 low elevations)	MGA14 Needle-and-Thread-Northern Wheatgrass-June Grass		
(Sandy 1)	MGA16 Needle-and-Thread-Northern Wheatgrass-Sand Grass		MGB4 Awnless Brome-Sand Grass
(Blowout 3)	MGA17 Western Wheatgrass-June Grass-Sedge		
(Thin Breaks 2)	MGA20 Northern Wheatgrass-Needle-and-Thread-June Grass	MGC3 Snowberry/Thread-leaved Sedge-June Grass	
(Saline Lowlands 2)	MGA19 Salt Grass-Western Wheatgrass-Sedge		

Table 13. Plant communities listed by ecological range site within the Mixedgrass Natural Subregion for the Lethbridge - Vulcan - Majorville Plains.

Ecological Range Site	Range Plant Community (Reference Plant Community)	Successional Community Types	Modified Plant Communities
Loamy 3	MGA21 Wheatgrass-Needle-and-Thread	MGA22 Needle-and-Thread-June Grass MGA23 Blue Grama Grass-Needle-and-Thread	
Loamy 7 **Little Bow** **Open Shrubland**		MGC4 Snowberry/Needle-and-Thread-Low Sedge-Northern Wheatgrass MGC5 Snowberry/Low Sedge-Northern Wheatgrass MGC6 Snowberry/Pasture Sagewort-Low Sedge	MGB6 Snowberry/Crested Wheatgrass-Pasture Sagewort MGB7 Snowberry/Awnless Brome-Kentucky Bluegrass MGB8 Snowberry/Canada Thistle-Kentucky Bluegrass
Sandy 2 **Little Bow**	MGA25 Snowberry/Northern Wheatgrass-Needle-and-Thread	MGA24 Needle-and-Thread-Low Sedge-Pasture Sagewort MGA26 Low Sedge-Pasture Sagewort-Northern Wheatgrass MGA27 Blue Grama Grass-Low Sedge-Needle-and-Thread	MGB5 Kentucky Bluegrass-Common Dandelion-Awnless Brome
Sands 1 **Little Bow**		MGA28 Snowberry/Needle-and-Thread-Sand Grass-Low Sedge	
Saline Lowlands 3 **Little Bow**		MGA29 Salt Grass-Foxtail Barley-Western Wheatgrass	

Table 14. Range plant communities and ecologically sustainable stocking rates (ESSR) by ecological range site within the Mixedgrass Natural Subregion within the Cypress Hills Upland.

Community Number (Range Site)	Community Type (**RPC(reference plant community)**, Successional, *Modified*)	ESSR AUM's/Acre	ESSR Range AUM's/Acre	ESSR acres/AU	ESSR Range acres/AU
MGA1	**Plains Rough Fescue-Western Porcupine Grass-Sedge**	0.38	0.3 - 0.43	32	28-40
MGA2	Western Porcupine Grass-Plains Rough Fescue	0.28	0.23-0.3	48	40-52
MGA3	Needle-and-Thread-June Grass	0.2	0.15-0.23	60	52-80
MGB1 **Loamy 1**	*Crested Wheatgrass-Pasture Sagewort*	0.25	0.20-0.28	48	43-60
MGA30 **Loamy 4**	**Western Porcupine Grass-Northern Wheatgrass-June Grass**	0.25	0.20-0.28	48	43-60
MGA4 **Loamy 5 low elevations**	**Needle and Thread-Northern Wheatgrass-June Grass**	0.24	0.2-0.28	50	43-60
MGA5 **Blowout 1**	**Needle and Thread-Plains Rough Fescue-Western Wheatgrass**	0.25	0.23-0.28	48	43-52
MGA9	**Silver Sagebrush/Northern Wheatgrass-June Grass**	0.23	0.2-0.25	52	43-60
MGC1 **Blowout 2**	Silver Sagebrush/Western Wheatgrass-June Grass	0.2	0.18-0.23	60	52-67
MGA31 **Shallow to Gravel**	MGA31 Plains Rough Fescue-Northern Wheatgrass - Western Porcupine Grass	0.31	0.27-0.4	39	30-45
MGA7 **Gravel**	**Plains Rough Fescue-June Grass-Northern Wheatgrass**	0.25	0.20-0.28	48	43-60
MGA8 **Thin Breaks 1**	**Plains Rough Fescue-Plains Muhly**	0.2	0.18-0.23	60	52-67
MGA6 **Saline Lowlands 1**	**Salt Grass-Sedge-Western Wheatgrass**	0.3	0.28-0.33	40	36-43

Table 15. Range plant communities and suggested ecologically sustainable stocking rates (ESSR) by ecological range site within the Mixedgrass Natural Subregion within the Milk River Upland.

Community Number (Range Site)	Community Type (RPC (reference plant community), Successional, *Modified*)	ESSR AUM's/Acre	ESSRRange AUM's/Acre	ESSR acres/AU	ESSR Range acres/AU
MGB2 **Overflow 1**	*Snowberry/Kentucky Bluegrass-Tufted Hair Grass*	0.5	0.47-0.53	24	22-25
MGC2 **Overflow 2**	Snowberry/Green Needle Grass-Kentucky Bluegrass	0.6	0.5-0.65	20	18-24
MGA10	**Idaho Fescue-Northern Wheatgrass-Needle-and-Thread**	0.37	0.33-0.43	32	28-36
MGA11	Idaho Fescue-Lupine	0.32	0.28-0.35	38	34-43
MGA12	Snowberry/Kentucky Bluegrass-Idaho Fescue	0.28	0.25-0.3	43	40-48
MGA13	Canada Bluegrass-Silky Perennial Lupine	0.2	0.18-0.23	60	52-67
MGB3 **Loamy 2**	*Awnless Brome-Alfalfa-Kentucky Bluegrass*	0.3	0.28-0.33	40	36-43
MGA14 **Loamy 6 low elevations**	**Needle and Thread-Northern Wheatgrass-June Grass**	0.3	0.28-0.33	40	36-43
MGA16	**Needle and Thread-Northern Wheatgrass-Sand Grass**	0.26	0.23-0.28	45	43-52
MGB4 **Sandy 1**	*Awnless Brome-Sand Grass*	0.23	0.2-0.25	52	48-60
MGA17 **Blowout 3**	**Western Wheatgrass-June Grass-Sedge**	0.23	0.2-0.25	52	48-60
MGA20	**Northern Wheatgrass-Needle-and-Thread-June Grass**	0.2	0.18-0.23	60	52-67
MGC3 **Thin Breaks 2**	Snowberry/Thread-leaved Sedge-June Grass	0.15	0.13-0.18	80	67-92
MGA19 **Saline Lowland 2**	**Salt Grass-Western Wheatgrass-Sedge**	0.4	0.37-0.43	30	28-32

Table 16. Range plant communities and ecologically sustainable stocking rates (ESSR) by ecological range site within the Mixedgrass Natural Subregion within the Lethbridge - Vulcan - Majorville Plains.

Community Number (Range Site)	Community Type (RPC(reference plant community), Successional, *Modified*)	ESSR AUM's/Acre	ESSR Range AUM's/Acre	ESSR acres/AU	ESSR Range acres/AU
MGA21	**Wheatgrass-Needle-and-Thread**	0.28	0.25-0.30	43	36-48
MGA22	Needle-and-Thread-June Grass	0.24	0.2-0.28	50	43-60
MGA23	Blue Grama Grass-Needle-and-Thread	0.2	0.18-0.23	60	52-67
Loamy 3					
MGC4	Snowberry/Needle-and-Thread-Low Sedge-Northern Wheatgrass	0.24	0.2-0.28	50	43-60
MGC5	Snowberry/Low Sedge-Northern Wheatgrass	0.2	0.18-0.23	60	52-67
MGC6	Snowberry/Pasture Sagewort-Low Sedge	0.15	0.13-0.18	80	67-92
MGB6	*Snowberry/Crested Wheatgrass-Pasture Sagewort*	0.2	0.18-0.23	60	52-67
MGB7	*Snowberry/Awnless Brome-Kentucky Bluegrass*	0.2	0.18-0.23	60	52-67
MGB8	*Snowberry/Canada Thistle-Kentucky Bluegrass*	0.1	.05-.015	120	80-240
Loamy 7					
MGA25	**Snowberry/Northern Wheatgrass-Needle-and-Thread**	0.26	0.23-0.28	46	43-52
MGA24	Needle and Thread-Low Sedge-Pasture Sagewort	0.23	0.2-0.25	52	48-60
MGA26	Low Sedge-Pasture Sagewort-Northern Wheatgrass	0.2	0.18-0.23	60	52-67
MGA27	Blue Grama Grass-Low Sedge-Needle-and-Thread	0.18	0.15-0.2	67	60-80
MGB5	*Kentucky Bluegrass-Common Dandelion-Awnless Brome*	0.18	0.15-0.2	67	60-80
Sandy 2					
MGA28	Snowberry/Needle-and-Thread-Sand Grass-Low Sedge	0.23	0.2-0.25	50	48-60
Sands 1					
MGA29	Salt Grass-Foxtail Barley-Western Wheatgrass	0.2	0.18-0.23	60	52-67
Saline Lowlands 3					

Plains Rough Fescue - Western Porcupine Grass - Sedge MGA1

(Festuca hallii-Stipa curtiseta-Carex) Herbaceous

n=28 First described by Coupland (1961), this is the reference plant community on loamy and shallow-to-gravel range sites in the Cypress Upland of southeastern Alberta and is strongly associated with the Wisdom, Tothill, Marmaduke and Plume soil series. While foothills rough fescue appears to dominate on the top of the Cypress Hills bench, plains rough fescue appears to be dominant on the slopes of the Cypress Hills Upland. Rough fescue is relatively sensitive to spring and early summer grazing and as grazing pressure increases, rough fescue is replaced by western porcupine grass, June grass, low sedge and needle-and-thread. This community type is quite productive and the first year's data from a new exclosure reflects recent drought conditions. This type normally has little exposed soil and moss/lichen cover is much more extensive than in Foothill Rough Fescue communities.

Soil Exposure: 3 % (1-29) **Moss/Lichen Cover:** 40 % (5-87) **Total Vegetation:** 86 % (66-95)

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Snowberry *(Symphoricarpos occidentalis)*	1	0-6	29
Forbs			
Prairie sagewort *(Artemisia ludoviciana)*	1	0-5	64
Pasture Sagewort *(Artemisia frigida)*	3	0-7	86
Moss phlox *(Phlox hoodii)*	1	0-5	71
Grasses			
Plains Rough Fescue *(Festuca hallii)*	50	19-85	100
Western Porcupine Grass *(Stipa curtiseta)*	11	0-38	86
Undifferentiated Sedge *(Carex)*	6	1-12	100
June Grass *(Koeleria macrantha)*	4	0-13	93
Northern Wheatgrass *(Agropyron dasystachyum)*	4	0-20	61
Needle-and-Thread *(Stipa comata)*	3	0-24	57
Western Wheatgrass *(Agropyron smithii)*	2	0-18	57
Idaho fescue *(Festuca idahoensis)*	2	0-10	36

Environmental Variables

Range Site: Loamy

Soils:
- Orthic Dark Brown (Wisdom, Marmaduke)
- Rego Dark Brown (Plume)

Elevation (m):
- 1100-1190

Soil Drainage:
- Moderate well drained
- Well Drained

Slope :
- Moderate
- Gentle
- Strong
- Nearly level

Aspect:
- Variable
- Southerly

Forage Production (lb/ac)

Grass 849 lb/ac
Forb 301 lb/ac
Shrub Not Available
Litter 1420
Total 1150
(new exclosure n=1yr)

Ecologically Sustainable Stocking Rates
0.38 AUM/ac

Western Porcupine Grass - Plains Rough Fescue - MGA2

(Stipa curtiseta - Festuca hallii) Herbaceous

n=28 This is the late-seral plant community on loamy and shallow-to-gravel range sites in the Cypress Upland of southeastern Alberta, and is strongly associated with Wisdom, Tothill, Marmaduke and Plume soil series. The corresponding reference plant community is MGA1. With moderate to heavy grazing pressure and consistent summer grazing use, rough fescue is replaced by western porcupine grass, June grass, needle-and-thread and numerous forbs like pasture sagewort. Moss and lichen cover also increase with grazing pressure.

Soil Exposure: 3 % (1-13) **Moss/Lichen Cover:** 53 % (17-78) **Total Vegetation:** 78 % (50-94)

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Silver Sagebrush (*Artemisia cana*)	1	0-7	18
Forbs			
Common Yarrow (*Achillea millefolium*)	1	0-8	68
Pasture Sagewort (*Artemisia frigida*)	5	0-12	96
Prairie Sagewort (*Artemisia ludoviciana*)	1	0-4	71
Grasses			
Western Porcupine Grass (*Stipa curtiseta*)	36	11-74	100
June Grass (*Koeleria macrantha*)	10	3-31	100
Undifferentiated Sedge (*Carex*)	9	1-29	100
Plains Rough Fescue (*Festuca hallii*)	6	0-26	50
Northern Wheatgrass (*Agropyron dasystachyum*)	6	0-29	68
Western Wheatgrass (*Agropyron smithii*)	4	0-21	82
Blue Grama (*Bouteloua gracilis*)	2	0-6	71
Needle-and-Thread (*Stipa comata*)	4	0-21	64

Environmental Variables

Range Site :
Loamy and Shallow-to-gravel

Soils:
Orthic Dark Brown (Wisdom, Tothill, Marmaduke, Plume)

Elevation (m): 1100-1190

Soil Drainage:
Well Drained
Moderate well drained
Poorly drained

Slope :
Moderate
Gentle
Strong

Aspect:
Variable

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Sustainable Stocking Rates
0.28 AUM/ac

Needle and Thread - June Grass - MGA3

(Stipa comata - Koeleria macrantha) Herbaceous

n=10 This is a early-to-mid - seral plant community in the Cypress Upland of southeastern Alberta. When it occurs on Wisdom, Tothill, Marmaduke or Plume soils it serves as an indicator of past grazing at very heavy rates. Due to the droughty nature of the Cypress Upland in contrast to rough fecue communities on black soil types, this site possesses good long-term recovery potential. Light stocking, rotational grazing to increase rest periods and management for litter accumulation will be important first steps to recovery.

Soil Exposure: 7 % (1-27) **Moss/Lichen Cover:** 46 % (7 - 80) **Total Vegetation:** 69% (48 - 83%)

Plant Composition

	Canopy Cover(%)		
	Mean	Range	Con
Forbs			
Pasture Sagewort *(Artemisia frigida)*	4	1-8	100
Scarlet Mallow *(Sphaeralcea coccinea)*	2	0-16	70
Broomweed *(Gutierrezia sarothrae)*	2	0-5	80
Grasses			
Needle-and-Thread *(Stipa comata)*	18	3-37	100
June Grass *(Koeleria macrantha)*	12	5-21	100
Undifferentiated Sedge *(Carex)*	10	0-18	90
Northern Wheatgrass *(Agropyron dasystachyum)*	9	0-22	70
Western Porcupine Grass *(Stipa curtiseta)*	8	0-17	90
Western Wheatgrass *(Agropyron smithii)*	9	0-22	70
Plains Rough Fescue *(Festuca hallii)*	7	0-14	90
Blue Grama *(Bouteloua gracilis)*	2	0-8	60
Bluebunch Fescue *(Festuca idahoensis)*	1	0-5	60

Environmental Variables

Range Site:
Loamy and shallow-to-gravel Blowout

Soils:
Orthic Dark Brown (Tothill, Wisdom)
Rego Dark Brown (Plume)
Dark Brown Solodized Solonetz
(Craigower)

Elevation (m): 991-1200

Soil Drainage:
Well drained
Moderate well drained

Slope :
Moderate, Gentle, Very gentle

Aspect:
N/A

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.2 AUM/ac

Needle and Thread - Northern Wheatgrass - June Grass MGA4

(Stipa comata - Agropyron dasystachyum - Koeleria macrantha) Herbaceous

n=4 This is the reference plant community for loamy range sites in the Cypress Upland of southeastern Alberta. This community is found at lower elevations in the Mixedgrass in the transition area to the Dry Mixedgrass (DMG). This community is distinguished from similar communities in the DMG by the high composition of northern wheatgrass and western porcupine grass on a dark brown chernozemic profile. Soil exposure is normally less than about 10% cover.

Soil Exposure: 7 % (1-20) **Moss/Lichen Cover:** 63 % (42 - 85) **Total Vegetation:** 60% (46 - 78%)

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Silver Sagebrush *(Artemisia cana)*	1	0-3	25
Forbs			
Pasture Sagewort *(Artemisia frigida)*	7	3-13	100
Common Yarrow *(Achillea millefolium)*	3	0-7	100
Moss Phlox *(Phlox hoodii)*	3	1-4	100
Grasses			
Needle-and-Thread *(Stipa comata)*	16	9-30	100
Northern Wheatgrass *(Agropyron dasystachyum)*	14	9-17	100
June Grass *(Koeleria macrantha)*	11	5-17	100
Undifferentiated Sedge *(Carex)*	10	7-18	100
Western Porcupine Grass *(Stipa curtiseta)*	9	0-18	75
Blue Grama *(Bouteloua gracilis)*	3	0-11	75
Plains Reed Grass *(Calamagrostis montanensis)*	1	0-3	75
Western Wheatgrass *(Agropyron smithii)*	1	0-3	50

Environmental Variables

Range Site:
Loamy

Soils:
Orthic Dark Brown (Wisdom, Tothill)
Rego Dark Brown (Plume)

Elevation (m):
1100 - 1200

Soil Drainage:
Moderate well drained

Slope :
Moderate

Aspect:
Variable

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
LitterNot Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.24 AUM/ac

Needle and Thread - Plains Rough Fescue - Western Wheatgrass MGA5

(Stipa comata - Festuca hallii - Agropyron smithii) Herbaceous

n=1 This is a preliminary reference plant community for blowout range sites in the Cypress Upland of southeastern Alberta. Plains rough fescue is found on the deeper portions of the soil landscape with western wheatgrass and June grass occupying the blowout pits. Stocking rates need to adjust for the lower productivity of this range site compared to MGA1 which is the reference plant community for loamy sites.

Soil Exposure: 6% **Moss/Lichen Cover:** 84 % **Total Vegetation:** 64%

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Forbs			
Pasture sagewort *(Artemisia frigida)*	10		100
Golden bean *(Thermopsis rhombifolia)*	2		100
Moss phlox *(Phlox hoodii)*	2		100
Undifferentiated everlasting *(Antennaria)*	2		100
Golden aster *(Heterotheca villosa)*	1		100
Grasses			
Needle-and-thread *(Stipa comata)*	18		100
Plains Rough Fescue *(Festuca hallii)*	15		100
June Grass *(Koeleria macrantha)*	14		100
Western Wheatgrass *(Agropyron smithii)*	13		100
Undifferentiated Sedge *(Carex)*	11		100
Salt Grass *(Distichlis stricta)*	7		100
Plains Reed Grass *(Calamagrostis montanensis)*	1		100

Environmental Variables

Range Site:
Blowout

Soils:
Dark Brown Solodized Solonetz (McAlpine)

Elevation (m):
1100-1200

Soil Drainage:
Moderate Well Drained

Slope :
Gentle

Aspect:
N/A

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.25 AUM/ac

Salt Grass - Sedge - Western Wheatgrass - MGA6

(Distichlis stricta - Carex - Agropyron smithii) Herbaceous

n=2 This is a late-seral to reference plant community for a saline lowland range site in the Cypress Upland of southeastern Alberta. This range site is strongly influenced by discharge of groundwater and accumulation of salts, hence the dominance of salt grass and western wheatgrass. A host of other salt tolerant species are present in this community including alkali cord grass, Nuttall's salt-meadow grass and muhly. On the slightly better drained portions of the landscape, more normal upland species are expressed like plains rough fescue. The saline lowland portion of the site may show a cyclic response to variation in total annual precipitation. Vegetation canopy cover will decline and bare soil increases during dry cycles, with a very strong cover of salt grass and western wheatgrass during wet cycles. This community type has a significant component of natural bare soil at about 19% cover.

Soil Exposure: 19 % (5-34) **Moss/Lichen Cover:** 26 % (4 - 47) **Total Vegetation:** 57% (50 - 64%)

Plant Composition

Canopy Cover(%)	Mean	Range	Const
Forbs			
Gumweed *(Grindelia squarrosa)*	1	0-2	50
Broomweed *(Gutierrezia sarothrae)*	2	0-3	50
Undifferentiated Everlastings *(Antennaria)*	1	0-2	50
Grasses			
Undifferentiated Sedge *(Carex)*	25	15-34	100
Salt Grass *(Distichlis stricta)*	17	0-14	50
Western WheatGrass *(Agropyron smithii)*	7	0-14	50
Undifferentiated Bluegrass *(Poa)*	6	2-10	100
Plains Rough Fescue *(Festuca hallii)*	6	0-11	50
Nuttall's Salt-Meadow Grass *(Puccinellia nuttalliana)*	5	0-10	50
June Grass *(Koeleria macrantha)*	3	0-6	50
Undifferentiated Muhly *(Muhlengergia)*	3	0-6	50
Alkali Cord Grass *(Spartina gracilis)*	3	0-5	50

Environmental Variables

Range Site
Saline Lowland

Soils
Dark Brown Solodized Solonetz (McAlpine, Craigower)

Elevation (m):
1000-1200

Soil Drainage:
Well Drained
Moderate Well Drained

Slope :
Nearly Level, Gentle

Aspect:
N/A

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.3 AUM/ac

Plains Rough Fescue - June Grass - Northern Wheatgrass MGA7

(Festuca hallii-Koeleria macrantha -Agropyron dasystachyum) Herbaceous

n=2 This is the reference plant community for shallow-to-gravel and gravel range sites in the Cypress Upland of southeastern Alberta and is most common at the upper elevations of the upland. Useful indicators of gravel subsoil include late yellow locoweed and purple milk vetch. Stocking rates need to be set at more conservative values as compared to loamy sites of similar elevation like MGA1. These sites have good recovery potential albeit slow with the more limited growing conditions associated with the gravel subsoil.

Soil Exposure: 0 % (0-0) **Moss/Lichen Cover:** 3 % (2-4) **Total Vegetation:** 72 % (62-83)

PLANT COMPOSITION

	CANOPY COVER(%) MEAN	RANGE	CONST
FORBS			
WILD VETCH *(Vicia americana)*	12	8-17	100
LOW GOLDENROD *(Solidago missouriensis)*	2	0-4	50
LATE YELLOW LOCOWEED *(Oxytropis monticola)*	3	0-6	50
PURPLE MILK VETCH *(Astragalus dasyglottis)*	1	0-1	100
PASTURE SAGEWORT *(Artemisia frigida)*	1	0-1	100
GRASSES			
PLAINS ROUGH FESCUE *(Festuca hallii)*	32	26-39	100
JUNE GRASS *(Koeleria macrantha)*	15	11-19	100
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	12	4-21	100
BLUNT SEDGE *(Carex obtusata)*	7	4-10	100
NEEDLE-AND-THREAD *(Stipa Comata)*	7	6-7	100
ALKALI BLUEGRASS *(Poa juncifolia)*	3	1-6	100
PLAINS BLUEGRASS *(Poa arida)*	1	0-2	50

ENVIRONMENTAL VARIABLES

RANGE SITE :
GRAVEL

SOILS:
ORTHIC DARK BROWN (MARMADUKE)

ELEVATION (M):
1075-1200

SOIL DRAINAGE:
WELL DRAINED

SLOPE :
LEVEL TERRACE

ASPECT:
LEVEL TERRACE

FORAGE PRODUCTION (LB/AC)

GRASS NOT AVAILABLE
FORB NOT AVAILABLE
SHRUB NOT AVAILABLE
LITTER NOT AVAILABLE
TOTAL NOT AVAILABLE

Ecologically Sustainable Stocking Rates
0.25 AUM/ac

Plains Rough Fescue - Plains Muhly MGA8

(Festuca hallii-Muhlenbergia cuspidata) Herbaceous Shrub

n=3 This is the reference plant community for thin break range sites in the Cypress Upland, at upper elevations. This community tends to be found on cooler north facing slopes. Mean soil exposure is 18% and so these sites may be prone to accelerated erosion. Plains muhly tends to be more common on thin break range sites with shallow soils with increased soil exposure.

Soil Exposure: 18 % (6-30) **Moss/Lichen Cover:** 20 % (18-23) **Total Vegetation:** 77 % (64-84)

PLANT COMPOSITION

	CANOPY COVER(%) MEAN	RANGE	CONST
SHRUBS			
SNOWBERRY *(Symphoricarpos occidentalis)*	4	0-9	67
FORBS			
GOLDEN BEAN *(Thermopsis rhombifolia)*	3	1-7	100
PASTURE SAGEWORT *(Artemisia frigida)*	3	0-6	67
GRASSES			
PLAINS ROUGH FESCUE *(Festuca hallii)*	17	0-31	100
UNDIFFERENTIATED SEDGE *(Carex)*	11	7-15	100
PLAINS MUHLY *(Muhlenbergia cuspidata)*	10	4-14	100
JUNE GRASS *(Koeleria macrantha)*	8	2-17	100
WESTERN PORCUPINE GRASS *(Stipa curtiseta)*	7	2-11	100
WESTERN WHEATGRASS *(Agropyron smithii)*	5	4-6	100
GREEN NEEDLE GRASS *(Stipa viridula)*	4	0-7	100
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	3	0-9	67
KENTUCKY BLUEGRASS *(Poa pratensis)*	3	0-8	33

ENVIRONMENTAL VARIABLES

RANGE SITE:
THIN BREAKS

SOILS:
ORTHIC DARK BROWN (WISDOM, TOTHILL)

ELEVATION (M):
1075-1200

SOIL DRAINAGE:
VARIABLE DRAINAGE

SLOPE :
STEEP SLOPES

ASPECT:
NORTH AND VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS NOT AVAILABLE
FORB NOT AVAILABLE
SHRUB NOT AVAILABLE
LITTER NOT AVAILABLE
TOTAL NOT AVAILABLE

Ecologically Sustainable Stocking Rates
0.2 AUM/ac

Silver Sagebrush / Northern Wheatgrass - June Grass MGA9

(Artemisia cana / Agropyron dasystachyum - Koeleria macrantha) Herbaceous Shrub

n=4 This is the reference plant community on blowout range sites in the Cypress Upland of southeastern Alberta at medium to lower elevations. This community closely corresponds to a community of the same name in the Dry Mixedgrass. The range site is in the late stages of the solonetzic soil development as hardpan structure begins to break down with improved internal drainage. This type has much lower soil exposure and significant moss/lichen cover than the DMG type.

Soil Exposure: 8% (1-20) **Moss/Lichen Cover:** 45% (14-66) **Total Vegetation:** 69% (51-79)

Plant Composition

	Canopy Cover(%)		
	Mean	Range	Const
Shrubs			
Silver sagebrush *(Artemisia cana)*	2	0-7	25
Forbs			
Pasture sagewort *(Artemisia frigida)*	6	0-9	100
Common yarrow *(Achillea millefolium)*	2	0-4	75
Prairie sagewort *(Artemisia ludoviciana)*	1	0-2	50
Grasses			
Northern wheatgrass *(Agropyron dasystachyum)*	24	16-37	100
June Grass *(Koeleria macrantha)*	16	8-23	100
Needle-and-thread *(Stipa comata)*	13	5-17	100
Western WheatGrass *(Agropyron smithii)*	12	5-26	100
Sandberg Bluegrass *(Poa sandbergii)*	6	1-14	100
Blue grama *(Bouteloua gracilis)*	4	1-7	100
Undifferentiated Sedge *(Carex)*	3	0-7	50
Western porcupine grass *(Stipa curtiseta)*	2	0-8	25

Environmental Variables

Range Site:
Blowout to Loamy

Soils:
Dark brown solodized solonetz

Elevation (m):
1000-1110

Soil Drainage:
Well Drained

Slope :
Gentle

Aspect:
southerly

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.23 AUM/ac

Idaho Fescue - Northern Wheatgrass - Needle-and-Thread MGA10

(Festuca idahoensis - Agropyron dasystachyum - Stipa comata) Herbaceous Shrub

n=148 This is the reference plant community for loamy range sites at upper elevations in the Milk River Upland of southern Alberta and is strongly correlated with the Purescape soil series. There is a particularly diverse mixture of grasses and forbs given the location of this community type between Foothills Fescue on the top of the Milk River Ridge and the dry Mixedgrass prairie to the east. Silvery lupine, golden bean, fringed sage and tufted white aster are the principle forb species. Western snowberry, prairie and woods rose are the most abundant shrubs, normally occurring as scattered patches on the landscapes. Minor amounts of silverberry, pin cherry and saskatoon occur in localized patches. Silver sagebrush occurs as scattered individual plants over the landscape. Productivity of this community type is surprisingly high with annual forage production averaging about 1733 lb/ac. Production on Idaho fescue and northern wheatgrass-dominated-sites is fairly stable over time. Adequate litter cover is essential to maintaining stable forage yields through dry conditions. Normal soil exposure is slightly higher at 5% in this community than in the adjoining Foothills Fescue Natural Subregion.

Soil Exposure: 5 % (0-37) **Moss/Lichen Cover:** 10 % (0-69) **Total Vegetation:** 81 % (29-98%)

PLANT COMPOSITION

	CANOPY COVER(%)		
	MEAN	RANGE	CONST
SHRUBS			
SNOWBERRY *(Symphoricarpos occidentalis)*	4	0-19	67
FORBS			
PASTURE SAGEWORT *(Artemisia frigida)*	3	0-12	98
SILKY PERENNIAL LUPINE *(Lupinus sericeus)*	2	0-9	62
GOLDEN BEAN *(Thermopsis rhombifolia)*	1	0-8	74
GRASSES			
IDAHO FESCUE *(Festuca idahoensis)*	26	2-57	100
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	15	1-50	100
NEEDLE-AND-THREAD *(Stipa comata)*	11	0-43	92
JUNE GRASS *(Koeleria macrantha)*	6	0-27	100
UNDIFFERENTIATED SEDGE *(Carex)*	5	0-17	95
GREEN NEEDLE GRASS *(Stipa viridula)*	5	0-22	76
KENTUCKY BLUEGRASS *(Poa pratensis)*	4	0-21	57
WESTERN PORCUPINE GRASS *(Stipa curtiseta)*	3	0-23	60

ENVIRONMENTAL VARIABLES

RANGE SITE:
LOAMY

SOILS:
ORTHIC DARK BROWN (PURESCAPE, LUPEN)
REGO DARK BROWN (WILDA)

ELEVATION (M):
1122 - 1279

SOIL DRAINAGE:
WELL DRAINED

SLOPE :
MODERATE
STRONG
VERY GENTLE

ASPECT:
NORTHERLY
SOUTHERLY

FORAGE PRODUCTION (LB/AC)

GRASS 1733 LB./AC.
FORB 366 LB./AC.
SHRUB NOT AVAILABLE
LITTER 1209 LB./AC.
TOTAL 2099 LB./AC.

Ecologically Sustainable Stocking Rates
0.37 AUM/AC

Idaho Fescue - Lupine MGA11

(Festuca idahoensis - Lupinus argenteus) Herbaceous

n=38 This is a late-seral plant community on loamy range sites in the Milk River upland of southern Alberta and is strongly associated with Purescape soils. This community is very similar to the reference plant community MGA10 and has been modified by moderate to heavy grazing pressure leading to a decline in the abundance of northern wheatgrass and increase in the abundance of forbs, especially lupine. Soil exposure may actually decline slightly with the slight increase of grazing resistant species like Kentucky bluegrass.

Soil Exposure: 2 % (0-19) **Moss/Lichen Cover:** 2 % (0-19) **Total Vegetation:** 91 % (69-98%)

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Snowberry *(Symphoricarpos occidentalis)*	3	0-11	63
Forbs			
Silvery perennial lupine *(Lupinus argenteus)*	7	0-15	84
Golden bean *(Thermopsis rhombifolia)*	4	0-15	89
Pasture sagewort *(Artemisia frigida)*	2	0-5	95
Tufted white prairie aster *(Aster ericoides)*	2	0-6	71
Grasses			
Idaho fescue *(Festuca idahoensis)*	17	5-30	100
Northern Wheatgrass *(Agropyron dasystachyum)*	15	4-56	100
June Grass *(Koeleria macrantha)*	9	2-25	100
Kentucky bluegrass *(Poa pratensis)*	6	0-17	84
Undifferentiated Sedge *(Carex)*	5	0-17	95
Needle-and-Thread *(Stipa comata)*	3	0-15	61
Awned wheatgrass *(Agropyron subsecundum)*	3	0-13	74

Environmental Variables

Range Site:
Loamy

Soils:
Orthic Dark Brown (Purescape, Lupen)
Rego Dark Brown (Wilda)
Orthic Black (Beazer)

Elevation (m):
1150-1270

Soil Drainage:
moderately well drained
well drained

Slope :
Moderate
strong
very gentle

Aspect:
northerly
southerly
westerly

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.32 AUM/ac

Snowberry / Kentucky Bluegrass - Idaho Fescue - MGA12

(Symphoricarpos occidentalis / Poa pratensis - Festuca idahoensis) Herbaceous

n=25 This is a mid-seral community on loamy range sites in the Milk River Upland of southern Alberta and is strongly correlated with Purescape soils. This community type is likely the result of heavy to very heavy stocking with season-long grazing. Idaho fescue and northern wheatgrass are reduced in abundance and replaced by Kentucky bluegrass. Kentucky bluegrass will provide abundant forage production during moist conditions but lacks drought hardiness and will provide poorer opportunities for extending the grazing season into autumn or early winter. This community occupies slightly moister portions of the landscape compared to MGA13 where Canada bluegrass tends to dominate under similar grazing pressure. Soil exposure in the community is lower than the reference plant community due to the increase in Kentucky bluegrass.

Soil Exposure: 1% (0-4) **Moss/Lichen Cover:** 1 % (0-8) **Total Vegetation:** 96% (87-98%)

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Snowberry *(Symphoricarpos occidentalis)*	10	0-25	96
Common Wild Rose *(Rosa woodsii)*	4	0-9	80
Forbs			
Silvery Perennial Lupine *(Lupinus argenteus)*	4	0-18	48
Golden Bean *(Thermopsis rhombifolia)*	2	0-9	80
Grasses			
Kentucky Bluegrass *(Poa pratensis)*	26	14-45	100
Idaho Fescue *(Festuca idahoensis)*	13	1-35	100
Green Needle Grass *(Stipa viridula)*	7	0-18	80
Sedge *(Carex)*	5	0-15	96
Northern WheatGrass *(Agropyron dasystachyum)*	3	0-12	92
Awned WheatGrass *(Agropyron subsecundum)*	3	0-10	84
June Grass *(Koeleria macrantha)*	2	0-8	80

Environmental Variables

Range Site:
Loamy

Soils:
Orthic Dark Brown (Purescape)

Elevation (m):
1150-1270

Soil Drainage:
Well drained

Slope :
Strong
Moderate
Gentle
Very gentle

Aspect:
Southerly

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
LitterNot Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.28 AUM/ac

Canada Bluegrass - Silky Perennial Lupine MGA13

(Poa compressa - Lupinus sericeus) Herbaceous Shrub

n=1 This is an early-to mid-seral plant community on loamy range sites in the Milk River Upland of southern Alberta, at higher elevations. This community has been transformed by very heavy grazing to being dominated by mostly grazing-resistant species. Recovery back to late-seral stages will take many years of proper stocking and rotational grazing. This community occupies slightly drier site positions than MGA12 where Kentucky bluegrass tends to dominate under similar grazing levels. Despite the heavy grazing history, bare soil is generally not an issue due to the increased ground cover from grazing resistant species.

Soil Exposure: 1% **Moss/Lichen Cover:** 1% **Total Vegetation:** 98%

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Snowberry *(Symphoricarpos occidentalis)*	4		100
Forbs			
Silky perennial lupine *(Lupinus sericeus)*	21		100
Golden bean *(Thermopsis rhombifolia)*	7		100
Grasses			
Canada bluegrass *(Poa compressa)*	27		100
Undifferentiated sedge *(Carex)*	4		100
Northern wheatgrass *(Agropyron dasystachyum)*	3		100
Idaho fescue *(Festuca idahoensis)*	2		100
Kentucky bluegrass *(Poa pratensis)*	1		100
Western wheatgrass *(Agropyron smithii)*	1		100
June grass *(Koeleria macrantha)*	1		100

Environmental Variables

Range Site:
Loamy

Soils:
Orthic Dark Brown (Purescape)

Elevation (m):
1150- 1270

Soil Drainage:
well drained

Slope :
strong

Aspect:
variable

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.2 AUM/ac

Needle-and-Thread - Northern Wheatgrass - June Grass MGA14

(Stipa comata - Agropyron dasystachyum - Koeleria macranthai Herbaceous

n=58 This is the reference plant community on loamy range sites in the Milk River Upland of southern Alberta, at lower elevations in transition to the Dry Mixedgrass (DMG) Natural Subregion. Our preliminary estimate of this elevation is <1110 m. The high relative abundance of northern wheatgrass and western porcupine grass distinguishes this community from the needle-and-thread - June grass type that is so common in the DMG. In late to mid-seral stages of this community, these will also be the first species to decline in abundance. The successional pathway from RPC to early-seral will follow much the same progression as observed on loamy sites in the Lethbridge and Vulcan Plains with fringed sage, blue grama grass, Sandberg bluegrass and June grass replacing the mid-grasses at very heavy stocking levels.

Soil Exposure: 10 % (0-39) **Moss/Lichen Cover:** 34 % (4-60) **Total Vegetation:** 60% (35-88%)

Plant Composition

	Canopy Cover(%)		
	Mean	Range	Const
Shrubs			
Snowberry (*Symphoricarpos occidentalis*)	2	0-23	34
Silver Sagebrush (*Artemisia cana*)	1	0-5	26
Forbs			
Pasture Sagewort (*Artemisia frigida*)	5	0-11	98
Golden Aster (*Heterotheca villosa*)	1	0-5	36
Grasses			
Needle-and-Thread (*Stipa comata*)	34	10-71	100
Northern Wheatgrass (*Agropyron dasystachyum*)	20	3-64	100
June Grass (*Koeleria macrantha*)	9	0-24	100
Blue Grama (*Bouteloua gracilis*)	7	0-20	97
Sandberg Bluegrass (*Poa sandbergii*)	6	0-37	98
Western Porcupine Grass (*Stipa curtiseta*)	4	0-23	40
Undifferentiated Sedge (*Carex*)	3	0-9	100
Thread-leaved Sedge (*Carex filifolia*)	3	0-13	67

Environmental Variables

Range Site:
Loamy

Soils:
Orthic Dark Brown (Purescape, Heartbreak, Kessler, Lethbridge)
Cumulic Regosol (Milk River))

Elevation (m):
1025-1110

Soil Drainage:
well drained
rapidly drained

Slope :
very gentle
Moderate

Aspect:
northerly
southerly

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.3 AUM/ac

Needle-and-Thread - Northern Wheat grass - Sand Grass MGA16

(Stipa comata - Agropyron dasystachyum - Calamovilfa longifolia) Herbaceous

n=37 This is the reference plant community for sandy range sites in the Milk River Upland of southern Alberta, at elevations at or below 1110 m. This plant community closely resembles MGA14, but sand grass serves as an accurate indicator of soils that are more coarse in texture. As grazing pressure increases, northern wheatgrass will decline in abundance and sand grass may increase along with other grazing resistant species like fringed sage, low sedge and June grass.

Soil Exposure: 6 % (0-29) **Moss/Lichen Cover:** 24 % (0-65) **Total Vegetation:** 74% (36-98)

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Snowberry *(Symphoricarpos occidentalis)*	4	0-19	59
Silver sagebrush *(Artemisia cana)*	1	0-5	27
Forbs			
Pasture sagewort *(Artemisia frigida)*	2	0-9	100
Golden aster *(Heterotheca villosa)*	1	0-5	59
Grasses			
Needle-and-Thread *(Stipa comata)*	32	5-58	100
Northern Wheatgrass *(Agropyron dasystachyum)*	15	1-41	100
Sand Grass *(Calamovilfa longifolia)*	12	2-42	100
June Grass *(Koeleria macrantha)*	6	1-18	100
Undifferentiated Sedge *(Carex)*	5	1-23	100
Western porcupine grass *(Stipa curtiseta)*	4	0-25	57
Sandberg bluegrass *(Poa sandbergii)*	3	0-12	81
Blue Grama *(Bouteloua gracilis)*	3	0-10	86

Environmental Variables

Range Site:
Sandy

Soils:
Orthic Dark Brown (Heartbreak, Kessler)
Cumulic Regosol (Milk River)

Elevation (m):
1025-1110

Soil Drainage:
Rapidly drained

Slope :
Very gentle
Moderate
Gentle

Aspect:
Northerly
Southerly
Variable

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.26 AUM·ac

Western Wheatgrass - June Grass - Sedge MGA17

(Agropyron smithii - Koeleria macrantha - Carex) Herbaceous

n=11 This is a reference plant community for a complex range site where blowout, clayey and loamy range sites intermix in the Milk River Upland of southern Alberta. This plant community is common at lower elevations of the Milk River Upland on lower benches where heavier textured soils and solonetzic soils occur. Solonetzic soils normally have eroded blowout pits, where clay and salt tolerant species like western wheatgrass and June grass are normally abundant. Potential productivity for this type is significantly less than for loamy range sites in the area. Bare soil at about 15% cover is normal for this plant community type.

Soil Exposure: 17 % (1-71) **Moss/Lichen Cover:** 15 % (1-31) **Total Vegetation:** 73% (29-88)

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Snowberry (*Symphoricarpos occidentalis*)	2	0-10	55
Silver sagebrush (*Artemisia cana*)	1	0-4	27
Forbs			
Pasture sagewort (*Artemisia frigida*)	4	0-8	91
Golden bean (*Thermopsis rhombifolia*)	3	0-6	55
Grasses			
Western wheatgrass (*Agropyron smithii*)	27	16-45	100
June Grass (*Koeleria macrantha*)	10	2-26	100
Blue Grama (*Bouteloua gracilis*)	8	2-30	100
Needle-and-Thread (*Stipa comata*)	6	0-21	82
Undifferentiated Sedge (*Carex*)	6	0-12	100
Idaho fescue (*Festuca idahoensis*)	5	0-18	55
Plains reed grass (*Calamogrostis montanensis*)	2	0-7	55
Canada bluegrass (*Poa compressa*)	2	0-8	27

Environmental Variables

Range Site:
Blowout, Loamy, Clayey

Soils:
Orthic Dark Brown
(Purescape, Hegson)
orthic Regosol

Elevation (m):
1073 - 1164

Soil Drainage:
rapidly drained
well drained
moderately well drained
poorly drained

Slope :
strong, very gentle, moderate

Aspect:
Easterly
Westerly

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.23 AUM/ac

Salt Grass -Western Wheatgrass - Sedge MGA19

(Distichlis stricta - Agropyron smithii - Carex) Herbaceous

n=6 This is a late-seral to reference plant community on a complex of range sites with saline lowland and loamy range sites intermixed in the Milk River Upland of southern Alberta, at elevations below 1110 m in the transition area to the Dry Mixedgrass. This range site is strongly influenced by discharge of groundwater and accumulation of salts, hence the dominance of salt grass and western wheatgrass. On the slightly better drained portions of the landscape, more normal upland species are expressed. The saline lowland portion of the site may show a cyclic response to variation in total annual precipitation. Vegetation canopy cover will decline and bare soil increases during dry cycles, with a very strong cover of western wheatgrass during wet cycles. This community type has a significant component of natural bare soil at about 15% cover.

Soil Exposure: 15 % (2-34) **Moss/Lichen Cover:** 9 % (0 - 47) **Total Vegetation:** 76% (50 - 96%)

PLANT COMPOSITION

	CANOPY COVER(%)		
	MEAN	RANGE	CONST
SHRUBS			
SNOWBERRY *(Symphoricarpos occidentalis)*	3	0-8	50
FORBS			
UNDIFFERENTIATED ARTEMISIA *(Artemisia)*	2	0-11	17
LANCE-LEAVED IRONPLANT *(Haplopappus lanceolatus)*	1	0-2	50
GRASSES			
SALT GRASS *(Distichlis stricta)*	29	12-60	100
WESTERN WHEATGRASS *(Agropyron smithii)*	14	5-23	100
UNDIFFERENTIATED SEDGE *(Carex)*	7	0-21	100
NEEDLE-AND-THREAD *(Stipa comata)*	6	0-19	50
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	6	0-17	50
KENTUCKY BLUEGRASS *(Poa pratensis)*	5	0-31	17
GREEN NEEDLE GRASS *(Stipa viridula)*	4	0-9	50
TUFTED HAIR GRASS *(Deschampsia cespitosa)*	4	0-17	50
JUNE GRASS *(Koeleria macrantha)*	3	0-9	100

ENVIRONMENTAL VARIABLES

RANGE SITE:
SALINE LOWLAND

SOILS:
DARK BROWN SOLODIZED
SOLONETZ ORTHIC DARK BROWN (PURESCAPE, KESSLER)
CUMULIC REGOSOL (MILK RIVER)

ELEVATION (M):
1146-1092

SOIL DRAINAGE:
WELL DRAINED
IMPERFECTLY DRAINED

SLOPE :
VERY GENTLE, MODERATE,
NEARLY LEVEL, LEVEL, STRONG

ASPECT:
SOUTHERLY
NORTHERLY

FORAGE PRODUCTION (LB/AC)

GRASS NOT AVAILABLE
FORB NOT AVAILABLE
SHRUB NOT AVAILABLE
LITTER NOT AVAILABLE
TOTAL NOT AVAILABLE

Ecologically Sustainable Stocking Rates
0.4 AUM/ac

Northern Wheatgrass - Needle-and-Thread - June Grass MGA20

(Agropyron dasystachyum - Stipa comata - Koeleria macrantha) Herbaceous Shrub

n=7 This is a reference plant community for thin break range sites in the Milk River Upland of southern Alberta and has a broad range of occurrences in terms of elevation. It may be present on south facing slopes at upper elevations above 1110 m or on more northerly slopes at lower elevations. Northern wheatgrass will be the first species to decline in cover as grazing pressure increases. Thin break sites are naturally droughty and so litter management is important. More exposed soil is present on thin break range sites than for loamy range sites.

Soil Exposure: 11 % (0-30) **Moss/Lichen Cover:** 20 % (2-34) **Total Vegetation:** 75% (47-95)

Plant Composition Canopy Cover(%)

	Mean	Range	Const
Shrubs			
Snowberry *(Symphoricarpos occidentalis)*	3	0-6	86
Silver sagebrush *(Artemisia cana)*	1	0-2	43
Forbs			
Pasture sagewort *(Artemisia frigida)*	3	0-6	100
Silky perennial lupine *(Lupinus sericeus)*	1	0-3	43
Grasses			
Northern Wheatgrass *(Agropyron dasystachyum)*	20	14-34	100
Needle-and-Thread *(Stipa comata)*	25	17-30	100
June Grass *(Koeleria macrantha)*	10	3-21	100
Western wheatgrass *(Agropyron smithii)*	7	0-19	57
Blue Grama *(Bouteloua gracilis)*	7	2-18	100
Sandberg bluegrass *(Poa sandbergii)*	5	1-14	100
Undifferentiated Sedge *(Carex)*	5	1-12	100
Thread-leaved sedge *(Carex filifolia)*	5	0-13	86

Environmental Variables

Range Site:
Thin breaks

Soils:
Orthic Dark Brown (Purescape, Heartbreak, Hegson)
Cumulic Regosol (Milk River))

Elevation (m):
1025-1200

Soil Drainage:
rapidly drained
well drained

Slope :
Strong
very gentle

Aspect:
northerly
southerly

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.2 AUM/ac

Wheat Grass - Needle-and-Thread MGA21

(Agropyron - Stipa comata) Herbaceous

n=5 This is the reference plant community for loamy range sites in the Lethbridge and Vulcan Plains of the Mixedgrass prairie and dark brown soil zone of southwestern Alberta. This is the same community type as the *Stipa-Agropyron* type described by Coupland (1950, 1961, 1973). Western and northern wheatgrass tend to dominate this type and behave as decreaser species as grazing pressure increases from moderate to heavy. Under heavy to very heavy grazing, needle-and-thread, blue grama grass and fringed sage will increase in abundance. Winter-fat is very common in this type and despite its high palatability, seems to persist even under heavy grazing pressure. The sample size for this community is small since most of this type was plowed for crop production in the early decades of the century and remaining parcels have been heavily grazed. The best remaining expanses of this grassland type are found west of Lethbridge on the Blood Reserve and the Animal Disease Research Institute (ADRI) lands.

Soil Exposure: 0 % (0-1) **Moss/Lichen Cover:** 25 % (1-98) **Total Vegetation:** 96 % (93-98)

PLANT COMPOSITION

	CANOPY COVER(%) MEAN	RANGE	CONST
SHRUBS			
WINTER-FAT *(Eurotia lanata)*	2	0-7	40
FORBS			
PASTURE SAGEWORT *(Artemisia frigida)*	5	2-13	100
COMMON GOAT'S BEARD *(Tragopogon dubius)*	1	0-3	80
GRASSES			
WESTERN WHEATGRASS *(Agropyron smithii)*	35	8-64	100
NEEDLE-AND-THREAD *(Stipa comata)*	12	0-28	80
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	12	0-33	60
UNDIFFERENTIATED SEDGE *(Carex)*	7	1-13	100
WESTERN PORCUPINE GRASS *(Stipa curtiseta)*	6	0-19	40
JUNE GRASS *(Koeleria macrantha)*	4	0-12	80
GREEN NEEDLE GRASS *(Stipa viridula)*	4	0-8	80
BLUE GRAMA *(Bouteloua gracilis)*	3	1-8	100
PLAINS REED GRASS *(Calamagrostis montanensis)*	2	0-12	20

ENVIRONMENTAL VARIABLES

RANGE SITE:
LOAMY

SOILS:
ORTHIC DARK BROWN
(LETHBRIDGE, WHITNEY)
ORTHIC REGOSOL

ELEVATION (M):
930- 1025

SOIL DRAINAGE:
WELL DRAINED

SLOPE:
NEARLY LEVEL TO GENTLY
UNDULATING

ASPECT:
VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS 1510 (1090-2498)
FORB 79 (11 - 199)
SHRUB NOT AVAILABLE
TOTAL 1589 (1101 - 2697)
LITTER 1482 (549 - 2752)

Ecologically Sustainable Stocking Rates
0.28 AUM/ac

Needle-and-Thread - June Grass - MGA22

(Stipa comata - Koeleria macrantha) Herbaceous

n=12 This is a mid-seral plant community for loamy range sites in the Lethbridge and Vulcan Plains of the Mixedgrass prairie and dark brown soil zones of southwestern Alberta. This community is the product of generally heavy grazing pressure that has reduced the abundance of western and northern wheatgrass, which have been replaced by needle-and-thread, June grass and blue grama, and grazing resistant forbs like fringed sage. Despite its high palatability, winter-fat appears to persist on these soils under heavy grazing pressure, though the stature and productivity of the plant is reduced. A significant increase in exposed soil may also accompany the increase in grazing pressure. With a number of years of light stocking or rest, wheatgrass species may become dominant once more. Since much of the native grassland in the dark brown soil zone of southwestern Alberta has been plowed for crop production, the remaining parcels tend to be small and fragmented. Consequently, they are often affected by weed species like bluebur, Russian thistle, flixweed and kochia.

Soil Exposure: 18 % (2-57) **Moss/Lichen Cover:** 33 % (0-71) **Total Vegetation:** 66% (37-88%)

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Winter-fat *(Eurotia lanata)*	2	0-16	33
Forbs			
Pasture Sagewort *(Artemisia frigida)*	7	0-30	83
Scarlet Mallow *(Sphaeralcea coccinea)*	2	0-9	58
Grasses			
Needle-and-Thread *(Stipa comata)*	48	26-96	100
June Grass *(Koeleria macrantha)*	14	1-34	100
Blue Grama *(Bouteloua gracilis)*	9	0-19	75
Western Wheatgrass *(Agropyron smithii)*	3	0-21	58
Low Sedge *(Carex stenophylla)*	3	0-10	33
Northern Wheatgrass *(Agropyron dasystachyum)*	3	0-7	67
Undifferentiated Sedge *(Carex)*	3	0-9	67
Plains Reed Grass *(Calamagrostis montanensis)*	1	0-2	58
Sandberg Bluegrass *(Poa sandbergii)*	1	0-3	33

Environmental Variables

Range Site:
Loamy

Soils:
Orthic Dark Brown (Readymade, Coaldale, Lethbridge)
Orthic Brown (Maleb, Cranford)

Elevation (m):
870 - 930

Soil Drainage:
Well drained

Slope :
Gentle
Moderate

Aspect:
Northerly
Southerly

Forage Production (lb/ac)

Grass 920 (410 - 2200)
Forb 190 (84 - 443)
Shrub Not Available
Total 1110 (500 - 2600)
Litter 750 (140 - 1400)

Ecologically Sustainable Stocking Rates
0.24 AUM/ac

Blue Grama - Needle-and-Thread - MGA23

(Bouteloua gracilis - Stipa comata) Herbaceous

n=6 This is the early-seral to mid-seral plant community for loamy range sites in the Lethbridge, Vulcan and Majorville Plains of the Mixedgrass prairie and dark brown soil zone of southwestern Alberta. Heavy to very heavy grazing pressure has replaced western and northern wheatgrass with blue grama grass and needle-and-thread grass creating a plant community more typical of loamy range sites in the Dry Mixedgrass prairie. The persistence of winter-fat seems contrary to conventional thinking. In the dry Mixedgrass it normally disappears rapidly with grazing due to its high palatability, but appears to persist in this moister Mixedgrass environment. The sample size for this community is small since most of this type was plowed for crop production in the early decades of the century and remaining parcels have been heavily grazed. Soil exposure shows a marked increase in comparison to the late-seral and reference plant community stages for this site type.

Soil Exposure: 15 % (0-38) **Moss/Lichen Cover:** 4 % (.2 - 11) **Total Vegetation:** 26% (13 - 38%)

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Forbs			
Winter-Fat *(Eurotia lanata)*	20	8-34	100
Bluebur *(Lappula squarrosa)*	1	0-3	33
Grasses			
Blue Grama Grass *(Bouteloua gracilis)*	34	12-66	100
Needle-and-Thread Grass *(Stipa comata)*	21	3-41	100
Sandberg Bluegrass *(Poa sandbergii)*	16	6-44	100
Undifferentiated Sedge *(Carex)*	3	0-8	50
Low Sedge *(Carex stenophylla)*	2	0-7	50

Environmental Variables

Range Site:
Loamy

Soils:
Orthic Dark Brown

Elevation (m):
870-930

Soil Drainage:
Well drained

Slope :
Nearly level

Aspect:
variable

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.2 AUM/ac

Needle-and-Thread - Low Sedge - Pasture Sage - MGA24

(Stipa comata - Carex stenophylla - Artemisia frigida) Herbaceous

n=82 This is a late-to mid-seral plant community on sandy to loamy range sites in the Lethbridge and Vulcan Plains of the Mixedgrass prairie. Grazing has reduced the composition of the taller mid-grass species like northern and western wheatgrass and green needle grass. The plant community now more closely resembles that typical of loamy sites in the Dry Mixedgrass prairie. With lighter stocking and deferred rotational grazing, this plant community will move upwards in succession towards MGA25. Soil exposure is increased and total vegetation canopy reduced due to grazing pressure.

Soil Exposure: 8% (0-29) **Moss/Lichen Cover:** 2 % (0-20) **Total Vegetation:** 59% (33-82%)

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Snowberry *(Symphoricarpos occidentalis)*	3	0-15	54
Prairie Rose *(Rosa arkansana)*	1	0-10	39
Forbs			
Pasture Sage *(Artemisia frigida)*	15	0-49	99
Golden Bean *(Thermopsis rhombifolia)*	1	0-18	40
Scarlet Mallow *(Sphaeralcea coccinea)*	1	0-8	71
Moss Phlox *(Phlox hoodii)*	1	0-8	40
Grasses			
Needle-and-Thread *(Stipa comata)*	29	10-69	100
Low Sedge *(Carex stenophylla)*	20	4-52	100
Blue Grama Grass *(Bouteloua gracilis)*	10	0-47	93
Northern WheatGrass *(Agropyron dasystachyum)*	9	0-27	98
June Grass *(Koeleria macrantha)*	2	0-21	70
Sandberg bluegrass *(Poa sandbergii)*	1	0-11	29

Environmental Variables

Range Site:
Loamy to Sandy

Soils:
Orthic Dark Brown (Whitney, Lethbridge, Kessler)

Elevation (m):
870-930

Soil Drainage:
Well drained

Slope :
Level
Very Gentle
Moderate
Strong

Aspect:
Variable
Southerly

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.23 AUM/ac

Snowberry / Northern Wheatgrass - Needle-and-Thread MGA25

(Symphoricarpos occidentalis / Agropyron dasystachyum - Stipa comata) Herbaceous

n=6 This is the reference plant community for loamy to sandy range sites in the Vulcan Plain of the Mixedgrass Natural Subregion. This plant community is related to Coupland's (1961, 1973) needle grass - northern wheatgrass type once considered to be the most extensive plant community in the Canadian prairies, now extensively cultivated. This community is common on floodplains adjoining the Little Bow River, on well drained sites with very gentle to level topography. This community closely resembles MGA21. Soil exposure is normally less than 5% with minor amounts of Moss/Lichen cover, presumably due the shading effect of the wheatgrass and interstitial sedges.

Soil Exposure: 4% (1-15) **Moss/Lichen Cover:** 1 % (0-3) **Total Vegetation:** 83 (65-90%)

PLANT COMPOSITION

	CANOPY COVER(%) MEAN	RANGE	CONST
SHRUBS			
SNOWBERRY *(Symphoricarpos occidentalis)*	9	0-18	83
PRAIRIE ROSE *(Rosa arkansana)*	4	0-12	83
FORBS			
PASTURE SAGE *(Artemisia frigida)*	15	0-37	100
PRAIRIE CROCUS *(Anemone patens)*	2	0-9	33
GRASSES			
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	26	19-42	100
NEEDLE-AND-THREAD *(Stipa comata)*	18	13-24	100
LOW SEDGE *(Carex stenophylla)*	10	6-15	100
BLUE GRAMA GRASS *(Bouteloua gracilis)*	4	0-9	83
JUNE GRASS *(Koeleria macrantha)*	2	0-8	83
KENTUCKY BLUEGRASS *(Poa pratensis)*	2	0-12	17
WESTERN WHEATGRASS *(Agropyron smithii)*	1	0-9	17
GREEN NEEDLE GRASS *(Stipa viridula)*	1	0-7	17

ENVIRONMENTAL VARIABLES

RANGE SITE:
- LOAMY
- SANDY

SOILS:
- ORTHIC DARK BROWN (LETHBRIDGE, KESSELER)

ELEVATION (M):
- 870-930

SOIL DRAINAGE:
- WELL DRAINED

SLOPE:
- LEVEL
- VERY GENTLE
- NEARLY LEVEL

ASPECT:
- VARIABLE

FORAGE PRODUCTION (LB/AC)

- GRASS NOT AVAILABLE
- FORB NOT AVAILABLE
- SHRUB NOT AVAILABLE
- LITTER NOT AVAILABLE
- TOTAL NOT AVAILABLE

Ecologically Sustainable Stocking Rates
0.26 AUM/ac

Low Sedge -Pasture Sage -Northern Wheatgrass - MGA26

(Carex stenophylla -Artemisia frigida -Agropyron dasystachyum) Herbaceous

n=6 This is a mid-to early-seral plant community on loamy to sandy range sites in the Lethbridge and Vulcan Plains of the Mixedgrass Natural Subregion of southwestern Alberta and corresponds to the reference plant community MGA25. Mid-grasses normally dominate, but are significantly reduced in cover and grazing resistant species, especially low sedge, pasture sage and blue grama have increased substantially. Long-term management changes are required to reverse this trend including lighter stocking and rotational practices like deferred rotation grazing. Soil exposure is remarkably low despite heavy grazing pressure due to the increased ground cover of grazing resistant species.

Soil Exposure: 0.1% (0-0.8) **Moss/Lichen Cover:** 7 % (1-22) **Total Vegetation:** 60% (49-70%)

PLANT COMPOSITION

	CANOPY COVER(%) MEAN	RANGE	CONST
SHRUBS			
SNOWBERRY *(Symphoricarpos occidentalis)*	2	0-5	50
FORBS			
PASTURE SAGE *(Artemisia frigida)*	29	13-41	100
WESTERN BLUEBUR *(Lappula occidentalis)*	6	0-23	67
FLIXWEED *(Descurainia sophia)*	3	0-15	33
SCARLET MALLOW *(Sphaeralcea coccinea)*	2	0-7	50
GRASSES			
LOW SEDGE *(Carex stenophylla)*	30	18-47	100
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	8	0-14	100
BLUE GRAMA GRASS *(Bouteloua gracilis)*	7	0-17	83
NEEDLE-AND-THREAD *(Stipa comata)*	6	1-8	100
SANDBERG BLUEGRASS *(Poa sandbergii)*	2	0-9	67
JUNE GRASS *(Koeleria macrantha)*	2	0-10	33
SALT GRASS *(Distichlis stricta)*	1	0-6	17

ENVIRONMENTAL VARIABLES

RANGE SITE:
LOAMY TO SANDY

SOILS:
ORTHIC DARK BROWN
(LETHBRIDGE, WHITNEY, KESSLER)

ELEVATION (M):
875-930

SOIL DRAINAGE:
WELL DRAINED

SLOPE :
LEVEL
NEARLY LEVEL

ASPECT:
VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS NOT AVAILABLE
FORB NOT AVAILABLE
SHRUB NOT AVAILABLE
LITTER NOT AVAILABLE
TOTAL NOT AVAILABLE

Ecologically Sustainable Stocking Rates
0.2 AUM/ac

Blue Grama Grass - Low Sedge - Needle-and-Thread - MGA27

(Bouteloua gracilis - Carex stenophylla - Stipa comata) Herbaceous

n=2 Similar to MGA26, this is an early-seral plant community on loamy to sandy range sites in the Lethbridge and Vulcan Plains of the Mixedgrass Natural Subregion in southwestern Alberta and corresponds to reference plant community MGA25. While MGA26 occurs on level to gently sloping sites, this community is found on moderate to strong slopes resulting in greater soil exposure and potential for soil erosion. Long-term rest and improved rotational grazing practices are required to improve the health of this site.

Soil Exposure: 20% (11-30) **Moss/Lichen Cover:** 2 % (2-3) **Total Vegetation:** 59% (46-69%)

PLANT COMPOSITION

	CANOPY COVER(%) MEAN	RANGE	CONST
SHRUBS			
SNOWBERRY *(Symphoricarpos occidentalis)*	4	0-4	50
FORBS			
PASTURE SAGE *(Artemisia frigida)*	5	0-10	50
SCARLET MALLOW *(Sphaeralcea coccinea)*	3	2-4	100
GRASSES			
BLUE GRAMA GRASS *(Bouteloua gracilis)*	49	43-55	100
LOW SEDGE *(Carex stenophylla)*	27	17-37	100
NEEDLE-AND-THREAD *(Stipa comata)*	6	6-7	100
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	5	0-9	100
SANDBERG BLUEGRASS *(Poa sandbergii)*	1	0-2	50

ENVIRONMENTAL VARIABLES

RANGE SITE:
LOAMY TO SANDY

SOILS:
ORTHIC DARK BROWN

ELEVATION (M):
875-950

SOIL DRAINAGE:
WELL DRAINED

SLOPE :
STRONG
MODERATE

ASPECT:
VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS NOT AVAILABLE
FORB NOT AVAILABLE
SHRUB NOT AVAILABLE
LITTER NOT AVAILABLE
TOTAL NOT AVAILABLE

Ecologically Sustainable Stocking Rates
0.18 AUM/ac

Snowberry / Needle-and-Thread - Sand Grass - Low Sedge - MGA28

(Symphoricarpos occidentalis / Stipa comata - Calamovilfa longifolia -Carex stenophylla) Herbaceous

n=4 This is a late-seral plant community on sand to sandy range sites in the Lethbridge and Vulcan Plains of southwestern Alberta. The reference plant community for this type is expected to be dominated by northern wheatgrass with a significant component of sand grass that is a reliable indicator of coarse textured soils. Needle-and-thread grass and sand grass also tend to act as increaser species as grazing pressure increases. This is a minor type associated with sand parent paterials adjoining stream and river channels like the Little Bow River. This plant community can be quite productive with proper stocking and rotation practices that provide adequate growing season rest. With soils that have favourable internal drainage, plant vigor and root development can be very strong. Overgrazed stands will lose root mass and then show the droughty character of the sand to sandy profile. With heavy grazing pressure, bare soil will increase and these soils will be prone to wind erosion.

Soil Exposure: 22% (4-49) **Moss/Lichen Cover:** 1 % (0-5) **Total Vegetation:** 47% (37-54%)

Plant Composition Canopy Cover(%)

	Mean	Range	Const
Shrubs			
Snowberry *(Symphoricarpos occidentalis)*	6	3-8	100
Prairie Rose *(Rosa arkansana)*	3	0-9	50
Forbs			
Pasture Sage *(Artemisia frigida)*	8	4-13	100
Golden Bean *(Thermopsis rhombifolia)*	5	0-11	75
Wild Licorice *(Glycyrrhiza lepidota)*	3	0-7	50
Low Goldenrod *(Solidago missouriensis)*	2	0-4	75
Grasses			
Needle-and-Thread *(Stipa comata)*	23	16-34	100
Sand Grass *(Calamovilfa longifolia)*	15	10-21	100
Low Sedge *(Carex stenophylla)*	9	2-16	100
Northern Wheatgrass *(Agropyron dasystachyum)*	7	1-12	100
Blue Grama Grass *(Bouteloua gracilis)*	5	0-17	100
June Grass *(Koeleria macrantha)*	2	0-4	75

Environmental Variables

Range Site:
Sandy

Soils:
Orthic Dark Brown

Elevation (m):
875-930

Soil Drainage:
Well drained

Slope:
Strong
Moderate

Aspect:
Southerly
Variable

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.23 AUM/ac

Salt Grass - Foxtail Barley - Western Wheatgrass - MGA29

(Distichlis stricta - Hordeum jubatum - Agropyron smithii) Herbaceous

n=10 This is a late-to-mid seral plant community on saline lowland range sites in the Lethbridge and Vulcan Plains of southwestern Alberta. This range site is strongly influenced by discharge of groundwater and accumulation of salts, hence the dominance of salt grass, western wheatgrass and foxtail barley, all very salt tolerant species. These sites tend to show a cyclic response to variation in total annual precipitation. Vegetation canopy cover will decline and bare soil increases during dry cycles, with very strong cover of western wheatgrass during wet cycles.

Soil Exposure: 20% (0-47) **Moss/Lichen Cover:** 0.7% (0-7) **Total Vegetation:** 59% (40-81%)

Plant Composition Canopy Cover(%)

	Mean	Range	Const
Forbs			
Canada Goldenrod *(Solidago canadensis)*	4	0-26	30
Common Pepper-Grass *(Lepidium densiflorum)*	3	0-15	60
Common Yarrow *(Achillea millefolium)*	2	0-8	60
Grasses			
Salt Grass *(Distichlis stricta)*	34	10-72	100
Foxtail Barley *(Hordeum jubatum)*	11	0-21	90
Fowl Bluegrass *(Poa palustris)*	5	0-34	50
Western Wheatgrass *(Agropyron smithii)*	5	0-18	70
Awnless Brome *(Bromus inermis)*	4	0-28	20
Prairie Sedge *(Carex praegracilis)*	3	0-16	30
Low Sedge *(Carex stenophylla)*	3	0-12	30
Wire Rush *(Juncus balticus)*	2	0-8	50
Plains Bluegrass *(Poa arida)*	2	0-14	40

Environmental Variables

Range Site:
Saline Lowlands

Soils:
Orthic Dark Brown

Elevation (m):
840-930

Soil Drainage:
Well drained

Slope:
Level

Aspect:
Variable

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.2 AUM/ac

Western Porcupine Grass - Northern Wheatgrass - June Grass -MGA30

(Sipa curtiseta - Agropyron dasystachyum- Koeleria macranthai Herbaceous

n= 14 This is the reference plant community for loamy range sites in the Cypress Upland of southeastern Alberta. This community is found at lower elevations in the Mixedgrass in the transition area to the Dry Mixedgrass (DMG). It is intermediate between MGA4 which occurs at the lowest elevations and MGA1which occurs at middle to upper elevations. Soil exposure is normally less than about 10% cover.

Soil Exposure: 7 % (1-20)**Moss/Lichen Cover:** 63 % (42 - 85) **Total Vegetation:** 60% (46 - 78%)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
FORBS			
PASTURE SAGE *(Artemisia frigida)*	4	0-29	100
PRAIRIE SAGE *(Artemisia ludoviciana)*	1	0-3	78
GRASSES			
WESTERN PORCUPINE GRASS *(Stipa curtiseta)*	32	13-56	100
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	11	1-29	100
JUNE GRASS *(Koeleria macrantha)*	9	5-17	100
UNDIFFERENTIATED SEDGE *(Carex)*	7	3-12	100
PLAINS ROUGH FESCUE *(Festuca hallii)*	5	0-19	43
WESTERN WHEATGRASS *(Agropyron smithii)*	2	0-16	50
BLUE GRAMA GRASS *(Bouteloua gracilis)*	2	0-17	86

ENVIRONMENTAL VARIABLES

RANGE SITE:
LOAMY

SOILS:
ORTHIC DARK BROWN (WISDOM, TOTHILL)
REGO DARK BROWN (PLUME)

ELEVATION (M):
1025-1110

SOIL DRAINAGE:
MODERATE WELL DRAINED

SLOPE :
MODERATE

ASPECT:
VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS NOT AVAILABLE
FORB NOT AVAILABLE
SHRUB NOT AVAILABLE
LITTER NOT AVAILABLE
TOTAL NOT AVAILABLE

Ecologically Sustainable Stocking Rates
0.25 AUM/ac

Plains Rough Fescue - Northern Wheat Grass - Western Porcupine Grass MGA31

(Festuca halii-Agropyron dasystachyum-Stipa curtiseta) Herbaceous

n=4 This is the reference plant community on gravel and shallow to gravel range sites in the Cypress Upland of southeastern Alberta and is strongly associated with the Marmaduke soil series. This community type closely resembles MGA1 but occurs on gravel and shallow-to-gravel sites. While foothills rough fescue appears to dominate on the top of the Cypress Hills bench, plains rough fescue appears to be dominant on the slopes of the Cypress Hills Upland. Rough fescue is relatively sensitive to spring and early summer grazing and as grazing pressure increases, rough fescue is replaced by western porcupine grass, June grass, low sedge and needle-and-thread. Productivity for this community type is limited by gravely soils This type normally has little exposed soil and moss/lichen cover is much more extensive than in Foothill Rough Fescue communities.

Soil Exposure: 2 % (1-3) **Moss/Lichen Cover:** 31 % (5-52) **Total Vegetation:** 86 % (67-93)

Plant Composition Canopy Cover(%)

	Mean	Range	Const
Forbs			
Wild vetch *(Vicia americana)*	4	3-6	100
Pasture sagewort *(Artemisia frigida)*	2	0-5	75
Grasses			
Plains Rough Fescue *(Festuca hallii)*	57	6-74	100
Northern Wheatgrass *(Agropyron dasystachyum)*	9	5-20	100
Western Porcupine Grass *Stipa curtiseta)*	8	4-16	100
June Grass *(Koeleria macrantha)*	7	3-13	100
Undifferentiated Sedge *(Carex)*	6	1-9	100
Needle-and-Thread *(Stipa comata)*	1	0-3	25
Sheep fescue *(Festuca ovina)*	1	0-2	25

Environmental Variables

Range Site
Shallow to Gravel

Soils Orthic Dark Brown (Marmaduke)

Elevation (m):
1181

Soil Drainage:
Well Drained

Slope :
moderte, gentle and nearly level

Aspect:
South

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not available
Total Not Available

Ecologically Sustainable Stocking Rates
0.31 AUM/ac

Snowberry / Kentucky Bluegrass - Tufted Hair Grass MGB2

(Symphoricarpos occidentalis / Poa pratensis - Deschampsia cespitosa) Herbaceous Shrub

n=3 This is a mid-seral plant community on overflow range sites in the Milk River Upland of southern Alberta. Overflow sites are found in aprons, fans and draws where overland flow enhances site moisture conditions. On hummocky terrain in the Milk River Upland, this community will also be found in snow catch areas where late winter snow drifts will enhance the local moisture supply of the site. The reference plant community may include species like green needle grass, tufted hair grass and rushes. These sites are often preferentially grazed by livestock in much the same way as riparian areas and consequently are prone to invasion by species like Kentucky bluegrass.

Soil Exposure: 0 % (0-0) **Moss/Lichen Cover:** 0 % (0-0) **Total Vegetation:** 98 % (98-98)

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Snowberry *(Symphoricarpos occidentalis)*	7	0-14	67
Forbs			
Common yarrow *(Achillea millefolium)*	1	0-1	100
Graceful cinquefoil *(Potentilla gracilis)*	2	0-9	80
Grasses			
Kentucky Bluegrass *(Poa pratensis)*	38	34-42	100
Tufted Hair Grass *(Deschampsia cespitosa)*	12	7-16	100
Timothy *(Phleum pratense)*	9	0-17	67
Wire rush *(Juncus balticus)*	7	2-11	100
Green needle grass *(Stipa viridula)*	6	0-13	67
Undifferentiated Sedge *(Carex)*	4	4-4	100
Slender Wheatgrass *(Agropyron trachycaulum)*	3	0-7	67
Awned Wheatgrass *(Agropyron subsecundum)*	2	0-7	33
Foxtail Barley *(Hordeum jubatum)*	1	1-2	100

Environmental Variables

Range Site:
Overflow

Soils:
Orthic Dark Brown (Purescape)

Elevation (m):
1150 - 1234

Soil Drainage:
Well drained to imperfectly drained

Slope :
Moderate
Gentle
Nearly level

Aspect:
Southerly

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.5 AUM/ac

Awnless Brome - Alfalfa - Kentucky Bluegrass MGB3

(Bromus inermis - Medicago sativa - Poa pratensis) Herbaceous

n=1 This is a modified plant community on loamy range sites in the Milk River Upland of southern Alberta, at upper elevations. This community has been modified by past grazing disturbance or by natural invasion processes to introduced agronomic species particularly awnless brome and alfalfa. Despite its being modified from native status, this community is dominated by desirable non-native species and can still be managed for forage productivity, watershed and soil/site protection. Bare soils should be monitored and where necessary, plant cover restored. In this example, soil exposure is too high and the risk of accelerated soil erosion is also increased.

Soil Exposure: 24 % **Moss/Lichen Cover:** 0 % **Total Vegetation:** 78 %

PLANT COMPOSITION

	CANOPY COVER(%) MEAN	RANGE	CONST
SHRUBS			
COMMON WILD ROSE *(Rosa woodsii)*	2		100
FORBS			
ALFALFA *(Medicago sativa)*	21		100
CREEPING WHITE PRAIRIE ASTER *(Aster falcatus)*	3		100
LOW GOLDENROD *(Solidago missouriensis)*	3		100
GOLDEN ASTER *(Heterotheca villosa)*	1		100
SMALL-LEAVED EVERLASTING *(Antennaria parvifolia)*	1		100
GRASSES			
AWNLESS BROME *(Bromus inermis)*	50		100
KENTUCKY BLUEGRASS *(Poa pratensis)*	16		100
SLENDER WHEATGRASS *(Agropyron trachycaulum)*	2		100
GREEN NEEDLE GRASS *(Stipa viridula)*	2		100
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	1		100

ENVIRONMENTAL VARIABLES

RANGE SITE:
LOAMY

SOILS:
CUMULIC REGOSOL (MILK RIVER)

ELEVATION (M):
1156 - 1280

SOIL DRAINAGE:
RAPIDLY DRAINED

SLOPE :
LEVEL

ASPECT:

FORAGE PRODUCTION (LB/AC)

GRASS NOT AVAILABLE
FORB NOT AVAILABLE
SHRUB NOT AVAILABLE
LITTER NOT AVAILABLE
TOTAL NOT AVAILABLE

Ecologically Sustainable Stocking Rates
0.3 AUM/ac

Awnless Brome - Sand Grass MGB4

(Bromus inermis - Calamovilfa longifolia) Herbaceous

n=1 This is a modified plant community on sandy soils in the Milk River Upland of southern Alberta. This community type is prelimary, but likely the result of natural invasion of awnless brome into community MGA16, with needle-and-thread and northern wheatgrass being replaced by awnless brome. Though altered to non-native species, modified communties can be managed for optimum forage production and to sustain the conservation benefits of plant cover and minimum of bare soil.

Soil Exposure: 47 % **Moss/Lichen Cover:** 4 % **Total Vegetation:** 59 %

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Common wild rose *(Rosa woodsii)*	3	3-3	100
Forbs			
Alfalfa *(Medicago sativa)*	7	7-7	100
Golden aster *(Heterotheca villosa)*	5	5-5	100
Creeping white prairie aster *(Aster falcatus)*	4	4-4	100
Broomweed *(Gutierrezia sarothrae)*	4	4-4	100
Grasses			
Awnless brome *(Bromus inermis)*	25	25-25	100
Sand grass *(Calamovilfa longifolia)*	12	12-12	100
Northern Wheatgrass *(Agropyron dasystachyum)*	6	6-6	100
Western Wheatgrass *(Agropyron smithii)*	6	6-6	100
Green needle grass *(Stipa viridula)*	6	6-6	100
Needle-and-Thread *(Stipa comata)*	5	5-5	100
June grass *(Koeleria macrantha)*	4	4-4	100

Environmental Variables

Range Site:
Sandy

Soils:
Cumulic Regosol (Milk river)

Elevation (m):
1075

Soil Drainage:
Rapidly drained

Slope :
Nearly level
Very gentle

Aspect:
N/A

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.23 AUM/ac

Kentucky Bluegrass - Common Dandelion - Awnless Brome - MGB5

(Poa pratensis - Taraxacum officinale - Bromus inermis) Herbaceous

n=2 This is a modified plant community on sandy to loamy range sites in Lethbridge and Vulcan Plains in the Mixedgrass Natural Subregion of southwestern Alberta. The plant community is characterized by disturbance species and noxious weeds. The plant community is found on north slopes where growing conditions are cool and relatively moist thus supporting disturbance species that are more common in the foothills fescue grassland. Recovery to a desirable native plant community seems very unlikely. Soil exposure is unacceptably high and soil erosion hazard will be significantly increased. Management emphasis needs to focus on noxious weed control and restoring the vigor and productivity of the agronomic grasses that now occupy the site.

Soil Exposure: 30% (8-52) **Moss/Lichen Cover:** 2 % (0-5) **Total Vegetation:** 66% (46-85%)

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Forbs			
Common Dandelion *(Taraxacum officinale)*	12	8-17	100
Common Nettle *(Urtica dioica)*	4	3-6	100
Canada Thistle *(Cirsium arvense)*	4	0-8	50
Hound's Tounge *(Cynoglossum officinale)*	4	0-8	50
Common Yarrow *(Achillea millifolium)*	4	1-7	100
Western Bluebur *(Lappula occidentalis)*	3	0-7	50
Golden Bean *(Thermopsis rhombifolia)*	3	0-6	50
Drummond's Milk Vetch *(Astragalus drummondii)*	3	0-6	50
Grasses			
Kentucky BlueGrass *(Poa pratensis)*	9	0-24	92
Awnless Brome *(Bromus inermis)*	3	0-9	67
Quack Grass *(Agropyron repens)*	4	0-8	50
Foxtail Barley *(Hordeum jubatum)*	3	0-6	50

Environmental Variables

Range Site:
Loamy to Sandy

Soils:
Orthic Dark Brown (Lethbridge, Whitney)

Elevation (m):
1100

Soil Drainage:
Well drained

Slope :
Strong
Very Strong

Aspect:
Northerly

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.18 AUM/ac

Snowberry / Crested Wheatgrass - Pasture Sage MGB6

(Symphoricarpos occidentalis / Agropyron pectiniforme - Artemisia frigida)

n=11 This is a modified plant community on loamy and sandy range sites in the Lethbridge and Vulcan Plains. This community is likely the product of very heavy grazing and invasion of the plant community by crested wheatgrass that spreads by seed into native prairie sod. Current thinking is that these communities have limited potential for recovery to native status. Grazing of the crested wheatgrass is important to reduce seed production which hastens further movement into native cover. Considerable bare soil is a normal feature of crested wheatgrass stands where vegetative ground cover and litter are normally very limited.

Soil Exposure: 15% (0-47) **Moss/Lichen Cover:** 0.1% (0-1) **Total Vegetation:** 54% (38-70%)

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Snowberry *(Symphoricarpos occidentalis)*	13	0-37	64
Saskatoon *(Amelanchier alnifolia)*	3	0-22	18
Forbs			
Pasture Sage *(Artemisia frigida)*	12	0-37	64
Wild Licorice *(Glycyrrhiza lepidota)*	2	0-14	18
Prairie Sagewort *(Artemisia ludoviciana)*	1	0-7	36
Grasses			
Crested Wheatgrass *(Agropyron pectiniforme)*	33	18-85	100
Low Sedge *(Carex stenophylla)*	8	0-35	64
Needle-and-Thread *(Stipa comata)*	8	0-42	73
Awnless Brome *(Bromus inermis)*	4	0-16	45
Blue Grama Grass *(Bouteloua gracilis)*	3	0-18	36
Northern WheatGrass *(Agropyron dasystachyum)*	2	0-5	82
Green Needle Grass *(Stipa viridula)*	2	0-9	27

Environmental Variables

Range Site:
Loamy and sandy

Soils:
Orthic Dark Brown

Elevation (m):
850-930

Soil Drainage:
Well drained

Slope :
Level
Strong

Aspect:
variable

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.2 AUM/ac

Snowberry / Awnless Brome - Kentucky Bluegrass MGB7

(Symphoricarpos occidentalis / Bromus inermis - Poa pratensis)

n=9 This is a modified plant community on moist loamy range sites in the Lethbridge and Vulcan Plains. The corresponding reference plant communities for this type are MGA21 and MGA25. Past heavy grazing or cultivation and abandonment resulted in a loss of native plant species. Through proper stocking to leave adequate carry over and rotational grazing practices that increase rest periods, this community may be managed in its modified state for stronger grass cover and vigor. Species like awnless brome and Kentucky bluegrass provide valuable forage but are more prone to the impacts of periodic dry conditions than are native species.

Soil Exposure: 6% (0-30) **Moss/Lichen Cover:** 0.1% (0-1) **Total Vegetation:** 58% (40-76%)

LANT COMPOSITION

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Snowberry *(Symphoricarpos occidentalis)*	11	0-28	89
Choke Cherry *(Prunus virginiana)*	3	0-14	33
Saskatoon *(Amelanchier alnifolia)*	2	0-15	22
Prickly Rose *(Rosa acicularis)*	2	0-12	33
Forbs			
Canada Thistle *(Cirsium arvense)*	6	0-22	44
Wild Licorice *(Glycyrrhiza lepidota)*	4	0-17	22
Pasture Sage *(Artemisia frigida)*	3	0-17	44
Broomweed *(Gutierrezia sarothrae)*	3	0-20	22
Alfalfa *(Medicago sativa)*	2	0-14	22
Grasses			
Awnless Brome *(Bromus inermis)*	31	18-59	100
Kentucky Blue Grass *(Poa pratensis)*	7	0-20	78
Crested Wheat Grass *(Agropyron pectiniforme)*	5	0-20	44

Environmental Variables

Range Site:
Loamy

Soils:
Orthic Dark Brown

Elevation (m):
850-930

Soil Drainage:
Well drained

Slope :
Strong
Very Strong

Aspect:
Northerly
variable

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.2 AUM/ac

Snowberry / Canada Thistle - Kentucky Bluegrass MGB8

(Symphoricarpos occidentalis / Cirsium arvense - Poa pratensis) Shrub Herbaceous

n=12 This is modified and highly disturbed plant community on moist loamy range sites in the Lethbridge and Vulcan Plains. This community is found on very heavily grazed loamy sites on flood plains adjoining streams and small rivers like the Little Bow where moisture seepage will be greater than what is expected for the reference plant community. The higher moisture regime is reflected in the presence of awnless brome, Kentucky bluegrass and fowl bluegrass. The stand is almost completely dominated by disturbance-induced and weedy species. The first priority for this community is to reduce noxious weed levels through by improving competition from grasses like awnless brome and Kentucky bluegrass. Spot weed control using appropriate control measures may be a high priority as well. With improved vigor of Kentucky bluegrass, this community type can be stocked a heavier rates (0.2-0.25 AUM/ac).

Soil Exposure: 7 % (0-25) **Moss/Lichen Cover:** 0.2 % (0-2) **Total Vegetation:** 70 % (38-89)

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Snowberry *(Symphoricarpos occidentalis)*	25	0-47	83
Prickly rose *(Rosa acicularis)*	2	0-14	33
Forbs			
Canada thistle *(Cirsium arvense)*	21	11-42	100
Canada goldenrod *(Solidago canadensis)*	4	0-21	58
Silverweed *(Potentilla anserina)*	2	0-19	25
Grasses			
Kentucky bluegrass *(Poa pratensis)*	9	0-24	92
Prairie Sedge *(Carex praegracilis)*	7	0-23	50
Foxtail Barley *(Hordeum jubatum)*	5	0-19	58
Awnless Brome *(Bromus inermis)*	3	0-9	67
Western Wheatgrass *(Agropyron smithii)*	3	0-16	50
Wire rush *(Juncus balticus)*	2	0-7	75
Fowl Bluegrass *(Poa palustris)*	2	0-9	42

Environmental Variables

Range Site:
Loamy, Sandy, Clay

Soils:
Orthic Dark Brown (Whitney, Lethbridge)

Elevation (m):
850-930

Soil Drainage:
well drained

Slope :
Level
Very gentle

Aspect:
Variable

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.01 AUM/ac

Silver Sagebrush / Western Wheat Grass - June Grass MGC1

(Artemisia cana / Agropyron smithii - Koeleria macrantha) Herbaceous Shrub

n=6 This late-seral plant community on blowout range sites in the Cypress Upland at low to medium elevations. Soils are dark brown solodized solonetz and are at the latter stages of the solonetzic soil development process where internal drainage is improved and the hardpan structure starts to break down. Successional changes are difficult to gauge on solonetzic soils. The relatively high abundance of wheatgrasses and June grass compared to MGA5 appears to be the result of moderate grazing. Plant communities on blowout range sites are best maintained with light to light-moderate grazing. Soil exposure averages 27%.

Soil Exposure: 27% (10-69) **Moss/Lichen Cover:** 35% (5-64) **Total Vegetation:** 50% (40-67)

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Silver sagebrush *(Artemisia cana)*	5	0-15	50
Forbs			
Common yarrow *(Achillea millefolium)*	3	0-10	83
Undifferentiated everlasting *(Antennaria)*	3	0-8	83
Grasses			
Western wheatgrass *(Agropyron smithii)*	17	9-26	100
June grass *(Koeleria macrantha)*	16	9-27	100
Northern wheatgrass *(Agropyron dasystachyum)*	11	0-21	67
Undifferentiated sedge *(Carex)*	7	3-13	100
Sandberg bluegrass *(Poa sandbergii)*	5	0-14	67
Western porcupine grass *(Stipa curtiseta)*	4	0-12	33
Undifferentiated bluegrass *(Poa)*	3	0-11	33
Blue grama *(Bouteloua gracilis)*	1	0-5	67
Plains reed grass *(Calamovilfa montanensis)*	1	0-3	33

Environmental Variables

Range Site:
- Blowout

Soils:
- Dark Brown Solodized Solonetz (Craigower)
- Orthic Dark Brown (Wisdom, Glennbanner))

Elevation (m):
- 1025-1110

Soil Drainage:
- Well Drained
- Moderately well drained

Slope :
- Very gentle
- Strong

Aspect:
- Variable

Forage Production (lb/ac)

- Grass Not Available
- Forb Not Available
- Shrub Not Available
- Litter Not Available
- Total Not Available

Ecologically Sustainable Stocking Rates
0.2 AUM/ac

Snowberry / Green Needle Grass - Kentucky Bluegrass MGC2

(Symphoricarpos occidentalis / Stipa viridula - Poa pratensis) Shrub Herbaceous

n=5 This is a late-seral plant community on overflow range sites in the Milk River Upland of southern Alberta. Overflow sites are found in aprons, fans and draws where overland flow enhances site moisture conditions. This community is very common in snow trap sites where late winter snow drifts will enhance local soil moisture during spring melt. These sites are prone to invasion by Kentucky bluegrass and may also be preferentially grazed by livestock.

Soil Exposure: 7% (0-30) **Moss/Lichen Cover:** 3% (0-5) **Total Vegetation:** 89% (75-98)

Plant Composition

	Canopy Cover(%) Mean	Range	Const
Shrubs			
Snowberry *(Symphoricarpos occidentalis)*	26	18-31	100
Common Wild Rose *(Rosa woodsii)*	7	3-16	100
Forbs			
Silky Perennial Lupine *(Lupinus sericeus)*	3	1-7	100
Prairie Sagewort *(Artemisia ludoviciana)*	1	0-2	80
Grasses			
Green Needle Grass *(Stipa viridula)*	16	7-22	100
Kentucky Bluegrass *(Poa pratensis)*	8	4-16	100
Idaho Fescue *(Festuca idahoensis)*	7	0-14	60
Undifferentiated Sedge *(Carex)*	6	2-11	100
Northern Wheatgrass *(Agropyron dasystachyum)*	6	1-12	100
Needle-and-Thread *(Stipa comata)*	3	0-8	80
June Grass *(Koeleria macrantha)*	2	0-2	100
Western Wheatgrass *(Agropyron smithii)*	2	0-12	20

Environmental Variables

Range Site:
Overflow

Soils:
Cumulic Regosol (Milk river)

Elevation (m):
1140

Soil Drainage:
rapidly drained

Slope :
Very strong
Steep

Aspect:
depressional

Forage Production (lb/ac)

Grass Not Available
Forb Not Available
Shrub Not Available
Litter Not Available
Total Not Available

Ecologically Sustainable Stocking Rates
0.6 AUM/ac

Snowberry / Thread-leaved Sedge - June Grass MGC3

(Symphoricarpos occidentalis / Carex filifolia - Koeleria macrantha) Shrub Herbaceous

n=1 This is a mid-to late-seral plant community on thin break range sites in the Milk River Upland of southern Alberta. Cover of mid-grasses like northern wheatgrass are diminished and low grazing resistant species are dominant. Considerable bare soil may be present. Range recovery will be particularly slow on these low producing sites.

Soil Exposure: 29% **Moss/Lichen Cover:** 26% **Total Vegetation:** 60%

PLANT COMPOSITION

	CANOPY COVER(%) MEAN	RANGE	CONST
SHRUBS			
SNOWBERRY *(Symphoricarpos occidentalis)*	11	11-11	100
FORBS			
LOW GOLDENROD *(Solidago missouriensis)*	3	3-3	100
PASTURE SAGEWORT *(Artemisia frigida)*	6	6-6	100
UNDIFFERENTIATED MILK VETCH *(Astragalus)*	2	2-2	100
GRASSES			
THREAD-LEAVED SEDGE *(Carex filifolia)*	19	19-19	100
JUNE GRASS *(Koeleria macrantha)*	11	11-11	100
NEEDLE-AND-THREAD *(Stipa comata)*	8	8-8	100
WESTERN PORCUPINE GRASS *(Stipa curtiseta)*	4	4-4	100
WESTERN WHEATGRASS *(Agropyron smithii)*	3	3-3	100
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	3	3-3	100
SANDBERG BLUEGRASS *(Poa sandbergii)*	3	3-3	100
PLAINS MUHLY *(Muhlenbergia cuspidata)*	3	3-3	100

ENVIRONMENTAL VARIABLES

RANGE SITE:
THIN BREAKS

SOILS:
CUMULIC REGOSOL (MILK RIVER)

ELEVATION (M):
1140

SOIL DRAINAGE:
RAPIDLY DRAINED

SLOPE :
VERY STRONG
STEEP

ASPECT:
VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS NOT AVAILABLE
FORB NOT AVAILABLE
SHRUB NOT AVAILABLE
LITTER NOT AVAILABLE
TOTAL NOT AVAILABLE

Ecologically Sustainable Stocking Rates
0.15 AUM/ac

Snowberry / Needle-and-Thread - Low Sedge - Northern Wheatgrass
MGC4

(Symphoricarpos occidentalis / Stipa comata - Carex stenophylla - Agropyron dasystachyum)

n=22 This is a late-to mid-seral plant community on loamy range sites in the Lethbridge and Vulcan Plain. This community is found on level and gentle slopes, but also on north slopes adjoining streams and rivers. The corresponding reference plant community for this site is likely dominated by northern and western wheatgrass. This community shows alteration due to moderate to heavy grazing, increasing the abundance of needle-and-thread and low sedge. Given the expansion of the ground cover of low sedge, soil exposure remains relatively low in this community type.

Soil Exposure: 3% (0-11) **Moss/Lichen Cover:** 0.6 % (0 - 8) **Total Vegetation:** 57% (30 -74%)

PLANT COMPOSITION

	CANOPY COVER(%) MEAN	RANGE	CONST
SHRUBS			
SNOWBERRY *(Symphoricarpos occidentalis)*	26	16-45	100
FORBS			
PASTURE SAGE *(Artemisia frigida)*	8	1-20	100
PRAIRIE SAGEWORT *(Artemisia ludoviciana)*	2	0-12	45
THREE-FLOWERED AVENS *(Geum triflorum)*	2	0-15	23
CUT-LEAVED ANEMONE *(Anemone multifida)*	1	0-10	32
GRASSES			
NEEDLE-AND-THREAD *(Stipa comata)*	20	10-45	100
LOW SEDGE *(Carex stenophylla)*	15	0-44	100
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	8	1-38	100
BLUE GRAMA GRASS *(Bouteloua gracilis)*	2	0-14	59
WESTERN WHEATGRASS *(Agropyron smithii)*	2	0-23	14
SAND GRASS *(Calamovilfa longifolia)*	1	0-14	23
SANDBERG BLUEGRASS *(Poa sandbergii)*	1	0-14	41

ENVIRONMENTAL VARIABLES

RANGE SITE:
LOAMY AND SANDY

SOILS:
ORTHIC DARK BROWN

ELEVATION (M):
850-930

SOIL DRAINAGE:
WELL DRAINED

SLOPE :
LEVEL
STRONG

ASPECT:
VARIABLE
NORTHERLY

FORAGE PRODUCTION (LB/AC)

GRASS NOT AVAILABLE
FORB NOT AVAILABLE
SHRUB NOT AVAILABLE
LITTER NOT AVAILABLE
TOTAL NOT AVAILABLE

Ecologically Sustainable Stocking Rates
0.24 AUM/ac

Snowberry / Low Sedge - Northern Wheatgrass MGC5

(Symphoricarpos occidentalis / Carex stenophylla - Agropyron dasystachyum)

n=11 This is a mid-seral plant community on loamy to sandy range sites in the Lethbridge and Vulcan Plain. The corresponding reference plant community for this site is likely dominated by northern and western wheatgrass. This community is the product of heavy grazing pressure with low sedge as an indicator of past grazing pressure. Bare soil is increased and may occur at levels up to 25% with increased risk of soil erosion. Western snowberry is more common on flood plain sites but may also be an considered a grazing increaser. This range site has good potential for recovery to a greater dominance by wheatgrasses and normally shows limited invasion by invasive grasses like Kentucky bluegrass.

Soil Exposure: 5% (0-24) **Moss/Lichen Cover:** 0 % (0 - 0.5) **Total Vegetation:** 60% (38 -78%)

PLANT COMPOSITION

	CANOPY COVER(%) MEAN	RANGE	CONST
SHRUBS			
SNOWBERRY *(Symphoricarpos occidentalis)*	39	21-63	100
FORBS			
PASTURE SAGE *(Artemisia frigida)*	6	0-10	91
PRAIRIE SAGEWORT *(Artemisia ludoviciana)*	4	0-19	45
SCARLET MALLOW *(Sphaeralcea coccinea)*	2	0-15	55
COMMON YARROW *(Achillea millefolium)*	2	0-11	36
GRASSES			
LOW SEDGE *(Carex stenophylla)*	17	6-37	100
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	8	1-35	100
NEEDLE-AND-THREAD *(Stipa comata)*	5	0-9	91
KENTUCKY BLUEGRASS *(Poa pratensis)*	2	0-13	36
BLUE GRAMA GRASS *(Bouteloua gracilis)*	2	0-11	36
CANADA BLUEGRASS *(Poa compressa)*	2	0-8	27
WESTERN WHEATGRASS *(Agropyron smithii)*	1	0-12	27

ENVIRONMENTAL VARIABLES

RANGE SITE:
LOAMY AND SANDY

SOILS:
ORTHIC DARK BROWN

ELEVATION (M):
850-930

SOIL DRAINAGE:
WELL DRAINED

SLOPE :
LEVEL
VERY GENTLE
STRONG

ASPECT:
VARIABLE
NORTHERLY
SOUTHERLY

FORAGE PRODUCTION (LB/AC)

GRASS NOT AVAILABLE
FORB NOT AVAILABLE
SHRUB NOT AVAILABLE
LITTER NOT AVAILABLE
TOTAL NOT AVAILABLE

Ecologically Sustainable Stocking Rates
0.2 AUM/ac

Snowberry /Pasture Sage - Low Sedge - MGC6

(Symphoricarpos occidentalis / Artemisia frigida - Carex stenophylla)

n=20 This is an early-seral plant community on loamy to sandy range sites in the Lethbridge and Vulcan Plains. The corresponding reference plant community for this site is likely dominated by northern and western wheatgrass, western porcupine grass, needle-and-thread grass and low sedge. This is a highly disturbed community and is the product of very heavy grazing pressure with fringed sage and low sedge as an indicators of past grazing pressure. Bare soil is significantly increased and may occur at extremely high levels. Western snowberry is more common on flood plain sites but may also be an considered a grazing increaser. Despite the disturbed character of this lease, this range site has good potential for recovery to a greater dominance by wheatgrasses and normally shows limited invasion by invasive grasses like Kentucky bluegrass.

Soil Exposure: 15% (1-70) **Moss/Lichen Cover:** 1 % (0 - 5) **Total Vegetation:** 58% (36 - 85%)

PLANT COMPOSITION

	CANOPY COVER(%)		
	MEAN	RANGE	CONST
SHRUBS			
SNOWBERRY *(Symphoricarpos occidentalis)*	24	7-50	100
FORBS			
PASTURE SAGE *(Artemisia frigida)*	29	13-53	100
GOLDEN BEAN *(Thermopsis rhombifolia)*	1	0-13	35
GOLDEN ASTER *(Heterotheca villosa)*	1	0-10	25
PRAIRIE SAGEWORT *(Artemisia ludoviciana)*	1	0-10	20
SCARLET MALLOW *(Sphaeralcea coccinea)*	1	0-6	35
CANADA GOLDEN ROD *(Solidago canadensis)*	1	0-3	50
GRASSES			
LOW SEDGE *(Carex stenophylla)*	13	0-45	95
BLUE GRAMA GRASS *(Bouteloua gracilis)*	7	0-36	70
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	8	0-36	100
NEEDLE-AND-THREAD *(Stipa comata)*	4	0-10	95
JUNE GRASS *(Koeleria macrantha)*	1	0-9	75

ENVIRONMENTAL VARIABLES

RANGE SITE:
LOAMY AND SANDY

SOILS:
ORTHIC DARK BROWN

ELEVATION (M):
850-930

SOIL DRAINAGE:
WELL DRAINED

SLOPE :
LEVEL
NEARLY LEVEL
STRONG

ASPECT:
VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS NOT AVAILABLE
FORB NOT AVAILABLE
SHRUB NOT AVAILABLE
LITTER NOT AVAILABLE
TOTAL NOT AVAILABLE

Ecologically Sustainable Stocking Rates
0.15 AUM/ac

7.0 Guidelines for Assessing Plant Community Structure, Soil Exposure and Litter Abundance and Noxious Weeds.

The following guidelines are designed for use with the Range Health Assessment for Grassland, Forest and Tame Pastures - Field Workbook (Adams et al. 2003). The range health protocol is available from the Rangeland Management Branch, Public Lands and Forests Division, Alberta Sustainable Resource Development as a field workbook in 2003. The following comments are to assist the user in interpreting the range health codes and instructions in the Mixedgrass Natural Subregion.

7.1 Question 1. Integrity and Ecological Status

Why is plant species composition important?

Plant species composition is a fundamental consideration in range health assessment. Plant species composition will influence a sites' ability to perform functions and provide products and services. Native plant communities evolve within their environment and slowly change over time as environmental factors change. Significant short-term changes in plant composition do not normally occur unless caused by significant disturbances like continuous heavy grazing, prolonged drought, prolonged high periods of precipitation, exotic species invasion, frequent burning or a timber harvesting treatment.

Changes in plant community may result from disturbance?

Plant species changes due to grazing pressure are predictable:

Perennial species that tend to be most productive and palatable are also the most sensitive to grazing and will decline with increased grazing pressure.

Species with lower forage value and greater adaptation to grazing pressure will increase in relative abundance.

Eventually very heavy grazing pressure will lead to weedy species that are adapted to more constant levels of disturbance.

What successional stages should we manage for?

Range management objectives tend to favor the later stages of plant succession (late-seral to reference plant community or good to excellent range condition). Late-seral plant communities tend to be superior in the efficient capture of solar energy, in cycling of organic matter and nutrients, in retaining moisture, in supporting wildlife habitat values and in providing the highest potential productivity for the site. Early-seral stages represent plant communities with diminished ecological processes, that are less stable and more vulnerable to invasion by weeds and non-natives species. They are also characterized by diminished resource values such as livestock forage production, wildlife habitat values and watershed protection.

How do management changes affect plant communities?

When disturbance impacts are reduced or removed, the present plant community may react in a number of ways. It may appear to remain static, or it may move toward a number of identifiable plant communities including the potential natural community. Some rangeland communities, due to disturbance history or a natural process of invasion, have become dominated by non-native species, called modified plant communities. To the best of our knowledge, long-term rest of these modified plant communities will not facilitate a return to a native plant community. When non-native plant communities are being evaluated, a separate set of questions is applied to determine the health status of modified plant communities.

How can I tell the ecological status of a plant community?

The plant community tables provide guidance in understanding the ecological status of a given plant community:

- **Reference Plant Community(RPC) Types** - plant communities considered to be the expression of potential natural community for the site. Where the the RPC is unknown, a late-seral plant community will occur instead.

- **Successional Plant Community Types** - identifies those communities that are seral to the RPC. These communities have had some modification due to disturbance. Seral status declines as you move down the column. Successional community types are not always defined.

- **Modified Plant Community Types** - are also seral plant communities to the RPC, but where disturbance history has altered the plant communities to a non-native or modified character. Cultivated and seeded plant communities may be included in this category and are denoted by the letter code - **Cu.**

7.2 Question 2 - Plant Community Structure

What is plant community structure and why is it important?

This parameter recognizes the importance of structure associated with the canopy cover of major life form groups (trees, shrubs, forbs and graminoids) in a plant community. A diverse plant community supports optimum nutrient cycling and energy flow. Different life forms or life form groups vary in canopy structure and rooting depths, using sunlight, water and nutrients from different zones in the vegetation canopy and soil. Plant community structure is important in maintaining net primary production, especially in forested rangelands, and in the maintenance of habitat values for a spectrum of wildlife species including browsing opportunities for ungulates, and feeding and nesting sites for breeding birds.

Scoring Plant Community Structure in the Mixedgrass Natural Subregion

- Mixedgrass plant communities are characterized by strong mid-grass structure and may also include shrubs species like snowberry, rose and silver sagebrush.

- Mid-grasses that best express plant community structure in the Mixedgrass include northern and western wheatgrass, western porcupine grass and green needle grass.

- Needle-and-thread grass is also a mid-grass but is normally lower in stature than the other mid-grasses. With the exception of dry and exposed growing environments, a canopy dominated by a high proportion of needle-and-thread with a low proportion of other mid-grasses would be considered to have diminished plant community structure.

- The presence of a high canopy cover of blue grama, June grass or Sandberg's bluegrass normally denotes a significant loss of plant community structure, unless the site is an exposed knoll top or thin break range site.

7.3 Question 3 - Does the site retain moisture (litter standards)

What is litter and how does it contribute to range health?

When functioning properly, a watershed captures, stores and beneficially releases the moisture associated with normal precipitation events. Uplands make up the largest part of the watershed and are where most of the moisture received during precipitation events is captured and stored. Live plant material from both vascular and non-vascular plants and **litter,** residual plant material, either standing, freshly fallen or slightly decomposed on the soil surface, are strongly linked to range health. Litter cover aids a number of important functions on rangeland including: water infiltration (slowing runoff and creating a path into the soil), reducing soil erosion from wind and water, reducing evaporative losses and reducing raindrop impact.

In grassland environments significant, incoming precipitation is lost as evapo-transpiration. Litter acts as a physical barrier to heat and water flow at the soil surface. Litter conserves moisture by reducing evaporation, making scarce moisture more effective. Studies show that forage yields are reduced by about 30 % during dry years when litter has been removed by fire or heavy grazing on foothill rangelands (Willms et. al 1986). Table 17 summarizes litter normals for the Mixedgrass Natural Subregion. Like climate normals, litter normals will be adjusted and refined over time as additional years of monitoring add to the normals.

How much is enough?

Our basic assumption is that healthy grazed sites that provide optimum grazing opportunities will have a characteristic litter level that will be maintained over time with light to moderate stocking rates. By monitoring a variety of different ecological range sites over time, we are able to establish a "litter normal" expressed as lb./ac. The litter normals recommended for the

Mixedgrass Natural Subregion are summarized in table 17. The litter normal relates to the potential productivity of lightly to moderately grazed sites.

- Most loamy range sites in the Mixedgrass will be Orthic Dark Drown Chernozems.
- Threshold values should be viewed as a starting point, a minimum level for establishing a basic level of moisture retention.
- While excessive litter may build up on black soil types, there do not appear to be any detrimental effects on grassland health in the Mixedgrass from having "too much" litter.
- Modified plant communities have a diminished potential to produce adequate litter levels since the non-native plant material is much more prone to weathering loss.

Table 17. Litter normals for the Mixedgrass Natural Subregion

Range Site	Litter Normal	Healthy >65% of normal	Healthy with problems 65 to35% of normal	Unhealthy <35% of normal	Data Source	Litter Values (lb./ac.)	n= years collected
>1100 M							
Loamy	900	>585	585-315	<315	• Bluefield[1] • Milk River Ridge[1] • Twin River[1]	1319 1251 1025	13 14 3
Blowout and SWG	600	>390	390-210	<210			
Thin Breaks	300	>195	195-105	<105			
<1100 M							
Loamy	600	>390	390-210	<210	• Lomond[1] • Warner Demo Site[1] • Lethbridge[1]	569 800 1482	13 4 13
Blowout and SWG	450	>290	290-160	<160	• Red Rock Coulee[1]	525	13
Thin Breaks	250	>160	160-90	<90			

[1] Rangeland Reference Area Site, Alberta Sustainable Resource Development, Rangeland Management Branch, Lethbridge.

7.4 Question 4. - Site/Soil Stability - Why is soil loss a concern for rangeland health?

Rangelands experience varying degrees of natural stability depending on climate, soil, topography and plant cover. The normal amount of sediment that will be produced by water and wind erosion processes from a particular site type is termed geologic erosion. Managers strive to prevent accelerated erosion due to land management practices by maintaining adequate vegetation cover and a minimum of exposed soil. Vegetation protects the soil surface from raindrop impact, it detains overland flow, maintains infiltration and permeability and protects the soil surface from erosion. Soil loss is a serious concern since erosion tends to remove the most valuable fractions from the soil, namely the finer lighter particles like clays, silts and organic matter which are most important to soil fertility and moisture holding capacity. Long-term studies show that ongoing soil loss due to overgrazing or other practices will eventually transform the soil to a shallower, drier, less productive and less stable soil type. Excess sediment production has a negative impact on water quality since the fine particles that are eroded have great potential to absorb and carry nutrients and chemicals.

Loamy range sites tend to have very low levels of natural soil exposure. It will be relatively easy to recognize human-caused bare soil and accelerated erosion where soil exposure levels are normally in the 3-7% range. Ecological sites that are normally unstable will tend to exhibit significant exposed soil and have shallow soil profiles (seepage and slumping areas, badlands, thin breaks, saline lowlands, solonetzic soils, some sandy soils). In these examples, training and experience is required to make accurate assessments of human-caused bare soil and accelerated erosion.

Human-caused bare soil is rated by considering the total bare soil on a range site minus the amount that is normally naturally occurring. The following table shows the normal range of mean soil exposure values observed in the plant community data. Loamy, sandy and shallow-to-gravel sites normally have less than 10% soil exposure. Higher amounts of exposed soil can be expected on blowout, sands, thin breaks and saline lowlands.

Table 18. Soil exposure normals for major range sites in the Mixedgrass Natural Subregion.

Range Sites	Expected Soil Exposure (% canopy cover)
Loamy and Shallow to Gravel	3-7%
Sandy	4-6%
Blowout	6-17%
Sands	20-25%
Thin Breaks	11-18%
Saline Lowlands	15-20%

7.5 Question 5 - Noxious weed infestation.

Noxious weeds are invasive plants that are alien species to the rangeland plant community. Weeds are seldom a problem in vigorous, well managed pastures although weed invasion may occasionally happen in healthy stands. Weeds may be introduced to relatively healthy stands through rodent burrows, but generally their presence indicates a degrading plant community. Noxious weeds diminish the agricultural productivity of a site, and threaten biological diversity, the structure, function, and sustainability of ecosystems. They diminish the multiple uses and values that range is normally capable of providing.

Weeds normally provide a strong message about range health. Weeds most often invade range where grazing practices have resulted in available niche space (bare soil, surplus moisture); available micro-habitats normally occupied by range plants, but now available to weeds due to overgrazing or some other land use or natural disturbance. Grazing management strives to maintain plant vigor and vegetation cover so that all niche space is filled by one or more plant speices that can occupy the site and thereby minimize weed invasion.

Rating noxious weed infestations should be guided by local weed lists of noxious weeds as provided by municipal weed control authorities. This question attempts to identify noxious (restricted weeds) infestation on a range site.

In the analysis of plot data, four noxious weeds were encountered including Canada thistle, leafy spurge, tall buttercup and toadflax. Several nuisance weeds were also encountered including perennial sow thistle and annual hawk's beard. Canada thistle was the most common occurring in about 5 percent of plots. On highly disturbed sites it occurred at up to 10 % canopy cover. All other weed species occurred at trace levels of frequency and cover.

Table 19 Percent Frequency[1] of Noxious and Nuisance Weeds in Range Plots by Natural Subregion and in Riparian Plots in Southern Alberta.

Natural Subregion n=sample plots	Canada Thistle	Tall Buttercup	Hound's Tongue	Toadflax	Perennial Sow Thistle
Dry Mixedgrass n=1628	1	0	0	0	0
Mixedgrass n=724	**5**	**0.3**	**0.3**	**0.1**	**0**
Foothills Fescue n=283	17	1	T	T	2
Foothills Parkland n=410	17	1	0	0	1

[1] Frequency means species are present in plots but does not imply infestation levels of the species in the transect

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APPENDIX 9.1 Ecological Range Site Definitions

Table 20. Ecological/range sites, with definitions and abbreviated AGRASID correlations. From McNeil (2003).

Ecological/ Range Site	Revised Definition	AGRASID 3.0 Correlation
Subirrigated (Sb)	Water table is close to surface during growing season, but rarely above.	Gleyed non-saline medium- to coarse-textured soils.
Riparian (Ri)	Zone most closely adjacent to stream and river channels. Also known as the lotic zone.	Any SLM with floodplain or stream channel landscape model (FP1,FP2, FP3, SC1-l, SC1-h, SC2, SC3or SC4)
Overflow (Ov)	Areas subject to water spreading and sheetflow. Typically on gentle inclines or terraces prone to stream overflow.	Inclined, low relief landscapes including fans and aprons; or soils developed on fans, aprons or terraces.
Wetland (WL)	Typically low-lying or depressional positions subject to occupation by water ranging from temporary to semi-permanent in duration. Also known as the lentic zone.	Non or weakly saline Gleysols or Organic soils. OR undifferentiated water bodies (ZWA) with any landscape model **except** W1, W2 or W3.
Clayey (Cy)	Clayey textured soils including silty clay, sandy clay, clay, and heavy clay. Generally >40% clay.	Fine- and very-fine-textured soil groups.
Loamy (Lo)	Includes loam, silt loam, silt, clay loam, sandy clay loam, and silty clay loam.	Medium- and moderately-fine textured soil groups.
Sandy (Sy)	Sandy-loam-textured soils.	Moderately coarse soil group.
Limy (Li)	Eroded or immature soils with free lime ($CaCO_3$) at the soil surface. Soil pH generally >7.5.	Eroded, Rego and Calcareous soils or subgroups.
Sand (Sa)	Loamy sand and sand soils, and not with a duned surface.	Very-coarse-textured soil group and not on duned landscape models.
Blowouts (BlO)	Areas with eroded surface pits reflecting the presence of abundant Solonetzic (hardpan) soils.	Dominant or Co-dominant Solonetzic Order Soils.
Choppy Sandhills (CS)	Loamy sand and sand soils with a duned land surface.	Very-coarse-textured soil groups with duned landscape models.
Thin Breaks (TB)	Areas with bedrock at or near the soil surface; largely vegetated. May include thin, eroded or immature soils on gentle to steep landscapes.	Landscape models l3m and l3h; OR layered, medium, or fine materials with mas pm of L6, L7, L8, L16, M5, or F5.
Shallow to Gravel (SwG)	Soil with 20 to 50 cm of a sandy or loamy surface overlying a gravel or cobble- rich substrate.	Layered materials denoted by mas pm (parent material) codes L4 or L5.
Saline Lowland	Areas with negligible vegetation due to	Saline Regosolic or Saline

[7]Ecological/ Range Site	Revised Definition	AGRASID 3.0 Correlation
(SL)	electrical conductivity (salts) and/or sodium adsorption ratio limitations.	Gleysolic series OR sodic Regosolic series.
Gravel (Gr)	Dominated by gravels or cobbles (>50% coarse fragments). May be covered by a mantle with few gravels, up to 20 cm thick.	Layered or coarse materials with mas pm codes L1, L17, L19, L21 or C1.
Badlands/ Bedrock (BdL)	Nearly barren lands with exposures of softrock or hardrock. Includes steep valley walls.	Specific Landscape Models I4h, I5.

[7]Ecological/range sites are listed in order from most productive to least productive.

Appendix 9.2 A Concise Guide to Assist Users of AGRASID

9.2.1 - AGRASID: SOIL LANDSCAPE MODELS

AGRASID 3.0 is the most recent version of the Agricultural Region of Alberta Soil Information Database (ASIC 2001). AGRASID is a digital compilation of soils and landscapes presented at a scale of 1:100,000.

The basic soil map unit of AGRASID is the Soil Landscape Model (SLM) (ASIC 2001). Soil Landscape Models include soil series codes, a unit number, and a landscape model (Figure 5). Soil series proportions in a polygon or SLM are either dominant (50 to 100%), co-dominant (30 to 50%), or significant (10 to 30%). The soil series code in SLMs in which one soil series is dominant are denoted with three-letter symbols. The soil series code in SLMs in which two or three soil series are co-dominant are denoted with four-letter codes, with the first two letters indicating the first co-dominant soil and the last two letters indicating the second co-dominant soil. For example, an SLM with the soil series symbols PULU indicates a co-dominant Purescape (PUR, Orthic Dark Brown) developed on glacial till and, Lupine (LUP, Orthic Black Chernozem) developed on medium glaciolacustrine parent material.

A soil model unit number between 1 and 21 following the soil series symbol generally indicates a significant component of a particular soil or soils (Table 21).

Examples of Soil Model Numbers Used in Soil Landscape Models

- A simple SLM with one dominant soil (PUR) is indicated as PUR1/U11. The soil model number 1 indicates a relatively pure unit with no significant identified soils. The landscape model U11 indicates a low-relief undulating landscape with slopes generally less than 2%.

- A complex SLM with two co-dominant soils (PUR and LUP) is indicated as PULU2/U1h-c. The soil model number 2 indicates a significant proportion of wet soils (Gleysols or gleyed subgroups). The landscape model U1h indicates undulating topography (slopes of 2 to 5%). The c modifier refers to the presence of channels (Table 25).

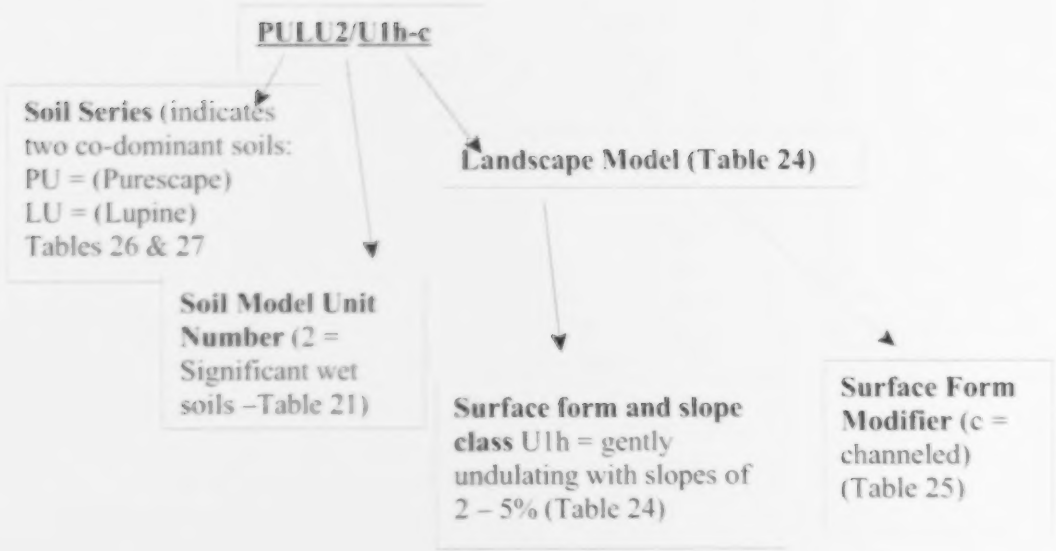
PULU2/U1h-c
Soil Series (indicates two co-dominant soils: PU = (Purescape) LU = (Lupine) Tables 26 & 27
Landscape Model (Table 24)
Soil Model Unit Number (2 = Significant wet soils –Table 21)
Surface form and slope class U1h = gently undulating with slopes of 2 – 5% (Table 24)
Surface Form Modifier (c = channeled) (Table 25)

Fig. 5 An example of an SLM code.

9.2.2 SOIL MODEL UNIT NUMBERS

Table 21. Description of Soil Model Unit Numbers.

Soil Model Unit Number	Significant Soil	Additional Description
1	Relatively pure unit.	No significant soils identified.
2	Wet, including gleyed subgroups, Gleysols or Organics	Gleyed are imperfectly drained; Gleysols and Organics are usually poorly or very poorly drained
3	Saline or salt-enriched	Saline phase or Saline subgroups
4	Eroded, Rego or Calcareous	Eroded and Thin phases, Rego or Calcareous subgroups
5	Finer textured	Soils must be at least one textural group finer (refer to textural triangle, Fig. 4) than the dominant or co-dominant soils.
6	Coarser textured	Soils must be at least one textural group coarser (refer to textural triangle, Fig. 4) than the dominant or co-dominant soils.
7	Solonetzic order	hardpan layer affected by sodium enrichment
8	Wet (2) and Eroded, Rego and Calcareous soils (4)	Both Soil Model Units 2 and 4 are present in significant proportions
9	Wet (2) and coarser (6)	Both Soil Model Units 2 and 6 are present in significant proportions
10	Wet (2) and Solonetzic (7)	Both Soil Model Units 2 and 7 are present in significant proportions
11	Eroded, Rego and Calcareous soils (4) and coarser textured (6)	Both Soil Model Units 4 and 6 are present in significant proportions
12	Wet (2), Eroded, Rego and Calcareous (4) and coarser textured (6)	The three Soil Model Units 2, 4 and 6 are present in significant proportions
13	Significant saline soils (3) and eroded Rego and Calcareous soils (4).	Both Soil Model Units 3 and 4 are present in significant proportions
14	Eroded, Rego and Calcareous (4) and	Both Soil Model Units 4 and 7 are present in significant

Soil Model Unit Number	Significant Soil	Additional Description
	Solonetzic (7)	proportions
15	Coarser textured (6) and Solonetzic (7)	Both Soil Model Units 6 and 7 are present in significant proportions
16	Chernozemic only if the dominant or co-dominant soils are Brunisolic, Luvisolic, Vertisolic, Regosolic, Solonetzic and/or Gleysolic	Significant Chernozemic soils in polygons dominated by soils of other orders.
17	Significant finer-textured soils (5) and significant Solonetzic soils (7).	Both Soil Model Units 5 and 7 are present in significant proportions
18	Wet (2) and finer-textured (5)	Both Soil Model Units 2 and 5 are present in significant proportions
19	Wet (2) and Chernozemic (16) only if the dominant or co-dominant soils are of a non-Chernozemic order.	Both Soil Model Units 2 and 16 are present in significant proportions
20	Imperfectly or freely drained soils (Gleyed subgroups) only if dominant or co-dominant soils are of the Gleysolic or Organic orders.	Dominantly poorly or very poorly drained soils, with significant non-Chernozemic soils that are either imperfectly or freely drained.
21	Dominant or two codominant Gleysolic soils with significant Organic soils.	Dominated by mineral wetland soils with significant areas of peat accumulation.

Variants

Variants of Soil Series are indicated as modifiers following the Soil Series code. Three examples are listed below. For a complete list of the 48 possible variants, see ASIC 2001.

co: Coarse-textured variation of the noted soil series. Textural class is at least one group coarser (Fig. 4). E.g., BZR is medium-textured, so a BZRco indicates at least a moderately-coarse-textured variation.

gl: Gleyed phase of the noted soil series. Soils are generally imperfectly drained, indicative of temporary wetlands. May also be indicative of a high watertable, which can promote subirrigation.

st: Stony phase used to indicate surface stoniness class of S3 or greater. Selected classes are defined in Table 22.

Table 22. Selected stoniness classes.

Stoniness Class	Description	% of Land Surface Covered By [Z]Stones or Boulders
S3	very stony	3 – 15
S4	excessively stony	15 – 50
S5	exceedingly stony	>50

[Z]Stones are 25 to 60 cm in diameter; boulders are >60 cm in diameter.

Undifferentiated Soil Models

Some soil landscapes are complex and may contain a wide variety of soil series. For these conditions undifferentiated soil models are used. Undifferentiated soil models begin with the letter Z, and reflect a broad grouping of particular soils that can include a soil order (E.g., ZSZ for Solonetzic), a soil subgroup (E.g., Gleyed is a component of ZGW), or a broad soil textural group (E.g., ZCO for coarse soils, Fig. 4). Nine undifferentiated soil models were used in AGRASID (Table 23).

Table 23. Description of Undifferentiated Soil Models.

Undifferentiated Soil Model Code	Description
ZCO	Coarse soils (gravel and sand)
ZER	Eroded mineral soils including Regosols and Rego and Calcareous subgroups
ZFI	Finer-textured soils (finer than indicated by series)
ZGW	Gleyed subgroups, Gleysols and water
ZNA	Saline soils
ZOR	Organic soils
ZSZ	Solonetzic order soils
ZUN	Undifferentiated mineral soils
ZWA	Water bodies

9.2.3 Landscape Models

Landscape Models reflect landform, surface shape, slope and relief. (Table 24). They are usually denoted with a capital letter followed by a number followed by a small letter. For a complete listing of landscape models, please refer to AGRASID Version 3.0 (ASIC 2001). Landscape models pertinent to Organic soil areas are not included for Range Guides of the Grassland Natural Region.

Table 24. Definition of Selected Landscape Models.

Code	Definition of Landscape Model	Predominant Slope Range (%)
DL	Disturbed land, including communities and facilities.	
D1l	Low-relief longitudinal dunes.	2 - 9
D1m	Moderate-relief longitudinal dunes.	5 - 15
D1h	High-relief longitudinal dunes.	9 - 30
D2l	Low-relief parabolic dunes.	2 - 9
D2m	Moderate-relief parabolic dunes.	5 - 15
D2h	High-relief parabolic dunes.	9 - 30
FP1	Unconfined meander floodplain.	0 - 5
FP2	Unconfined braided channel.	0 - 5
FP3	Confined floodplain with or without low-level terraces.	0 - 5

Code	Definition of Landscape Model	Predominant Slope Range (%)
HR2m	Moderate-relief hummocky and ridged.	5 - 15
HR2h	High-relief hummocky and ridged.	9 - 30
H1l	Low-relief hummocky.	4 - 9
H1m	Moderate-relief hummocky.	7 - 15
H1h	High-relief hummocky.	12 - 30
H5l	Low-relief hummocky draped moraine over softrock.	4 - 9
H5m	Moderate-relief hummocky draped moraine over softrock.	7 - 15
H5h	High-relief hummocky draped moraine over softrock.	12 - 30
I3l	Inclined, generally single slope landform, including fans and aprons.	2 - 9
I3m	Inclined; generally single slope moderate-relief landform.	6 - 15
I3h	Inclined and steep; generally single slope high relief landforms with 0 to 10% exposed bedrock.	15 - 60
I4l	Inclined; generally single slope low-relief landforms with >10% exposed softrock.	2 - 9
I4m	Inclined; generally single slope moderate-relief landforms with >10% exposed softrock.	6 - 15
I4h	Inclined and steep; generally single slope high-relief landforms with >10% exposed softrock.	15 - 60
I5	Inclined steep with extensive failure slumps.	15 - 60
IUl	Combination of inclined and undulating; generally a wavy pattern of gentle slopes on an overall inclined landscape.	1 - 5
IUh	Combination of inclined and undulating to hummocky; generally a wavy pattern of gentle to moderate slopes on an overall inclined landscape.	3 - 9
L1	Level plain.	0 - 2
L2	Level closed basin (depression with raised edges).	0 - 2
L3	Level and terraced; not within modern stream channels.	2 - 5
M1m	Moderate-relief rolling, including multi-directional inclined slopes greater than 400 m in length.	6 - 15
M1h	High-relief rolling, including multi-directional inclined slopes greater than 400 m in length.	15 - 30
R2l	Low-relief ridged landscape.	2 - 5
R2m	Moderate-relief ridged landscape.	6 - 15
R2h	High-relief ridged landscape.	12 - 30
SC1-l	Steep-sided valleys with a confined floodplain; low relief.	1 - 9
SC1-h	Steep-sided valleys with a confined floodplain; high relief.	9 - 60
SC2	Incised stream channel in wide valley with one or more terraces.	2 - 60
SC3	V-shaped valley with no terraces or floodplain.	2 - 60
SC4	Intermittently incised subglacial stream channel; partially infilled with glacial deposits.	2 - 60
U1l	Gently undulating or wavy pattern.	0.5 - 2
U1h	Undulating or wavy pattern.	2 - 5
W1	Channels, sloughs and ponds in a linear arrangement.	0 - 1
W2	Sloughs in a non-aligned aggregation.	0 - 1
W3	Level basin that may be filled or partially filled with water. Semi-permanent to permanent water body.	0 - 1

Landscape models sometimes include the following surface form modifiers (Table 25).

Table 25. Surface Form Modifiers.

Surface Form Modifier Code	Description
c	Channeled or rilled due to water erosion. Includes narrow and shallow temporary watercourses. Used when four or more channels occur within a cross-sectional distance of 800 m.
d	Dissected or gullied due to water erosion. Includes narrow to wide deep watercourses that interfere with ground transportation.
e	Eroded pits. Areas with more than 40% blowouts.
n	Concave or basinal water collection areas affected by surface water collection and/or groundwater discharge.
r	Shallow to bedrock. Bedrock is 1 to 5 m below ground surface

9.2.4 LISTING OF SOIL SERIES FOR THE FOOTHILLS FESCUE (SCAs 2 & 3)

Soil series are defined on the basis of detailed features of the soil pedon, such as colour, lithology, texture, and structure. Soil series reflect a unique combination of a soil subgroup and parent material that is present over a representative land area. Soil series are named for geographic points (e.g. towns) located in the area where they occur, and each soil series is denoted with a three-letter symbol. Soil series descriptions include soil subgroup, texture (Fig. 4) and parent material. A change in any of the three properties can result in a new soil series if there is sufficient area mapped in its applicable Soil Correlation Area.

Table 26. Soil Series of SCA 2. Mainly Dark Brown Soils of the Highland Areas of the Mixedgrass Natural subregion (Mixedgrass Highlands).

Soil Order and/or Great Group	Soil Sub-group	Parent Material, Surface Expression, Texture													
		Softrock	Till			Lacustrine		Glaciofluvial						Glaciofluvial or Fluvial-Eolian Blanket	Eolian on Cypress Plateau
		All types	Veneer over softrock	Blanket		Blanket	Veneer over till	Blanket		Veneer over till	Veneer over lacustrine	With Gravels in upper cypress Hills or Escarpment			
		Mod. fine	Mod. fine over all types	Moderately fine	Fine till or lacustro-till	Medium to mod. fine	Medium to mod fine	Medium or mod. coarse	Medium fluvial over gravelly very coarse fluvial	Mod. coarse over mod fine	Mod. coarse over mod fine	Gravelly Medium fluvial	Gravelly very coarse	Very coarse	Mod. fine
Chernozem	Orthic Dark Brown		Philp **PLP**	[Z]Wisdom **WSM** Tothill **TTH** Purescape **PUR** Sproule **SOL**	Hegson **HEG**	[Y]Rush Lake **RLK** Glenbanner **GNN**	Lupen **LUP**	Kessler aa **KSR-AA**	Marmaduke **MMD**	Migra **MGR**	Forl **FOR**		Delmas **DMS**	Heartbreak **HRK**	
	Rego Dark Brown			[X]Phune **PME** Wookchester **WCR** Wilda **WID**											
	Orthic Black	Dempster **DPT**		Elkwater **EKW**											Thelma **THA**
Dark Brown Solonetz	Solo-dized Solonetz		Minda **MNA**	[W]Maher **MHR** Grudge **GRG** McAlpine **MCA**		Craigower **CGW**									
Luvisol	Dark Gray											Reesor **RSR**			

[Z] PUR occurs on the Milk River Ridge, SOL in the Sweetgrass Upland, TTH in the Lower Cypress Hills, and WSM in the Upper Cypress Hills.
[Y] RLK and GNN are both moderately fine. RLK occurs in the Upper Cypress Hills and GNN occurs in the Lower Cypress Hills.
[X] PME occurs in the Upper Cypress Hills, WCR in the Lower Cypress Hills, and WID on the Milk River Ridge and Sweetgrass Upland.
[W] GRG occurs on the Milk River Rdige and Sweetgrass upland; MCA in the Upper Cypress Hills; MHR in the Lower Cypress Hills.

Table 27. Soil Series of SCA 3. Dark Brown soil zone of the Plains portions of the Mixedgrass Natural Subregion. (Mixedgrass Plains).

Soil Order and/or Great Group	Soil Subgroup	Parent Material, Surface Expression, Texture										
		Till		Lacustrine				Glaciofluvial				
		Veneer over softrock	Blanket	Blanket	Blanket	Veneer over till	Veneer over glacio-fluvial	Blanket	Veneer over lacustrine	Veneer over till	Veneer over gravels	With gravels
		Mod. fine over sandstone and siltstone	Mod. fine	Fine	Medium to mod. fine	Medium to mod fine	Medium over mod. coarse	Medium or mod. coarse	Mod. coarse over mod. fine	Gravelly mod. fine over medium	Medium over very gravelly very coarse	Very gravelly very coarse
Dark Brown Chernozem	Orthic	Van Cleeve **VAC**	[7]Craddock **CRD** Pulteney **PUY** Ready made **RDM**	[5]Coaldale **CLD** Magrath **MGT**	Lethbridge **LET**	Whitney **WNY**	Oasis **OAS**	Kessler **KSR**	Carmangay **CMY**		Crowfoot **CFT**	New Dayton **NED**
	Rego		[7]Verburg **VEB**	Brocket BKE Welling **WLG**	Diamond **DIM**					Wollum **WOL**		
	Calcareous		[7]NineMile **NEM**		Chokio **CIO**			Olsen **OSN**				MacLeod **MAC**
	Solonetzic				[5]Kirkcharnp **KCH**	Pagent **PGT**						
	Orthic Saline				Lilydale **LLD**							
Dark Brown Solonetz	Solod				Arrowwood **AWD**		Kirkaldy **KRK**					
	Solodized Solonetz		Parr **PAR**		Kehel **KHO**		Lakesend **LSD**					
	Solonetz				Idamay **IMY**							
Regosolic	Orthic			Weston **WTN**								
	Orthic Saline				Kytscap **KCP**							
	Cumulic or C. Humic							[9]Jensen Reservoir **JSR** Sexton **SXT**				
Gleysolic	Orthic				Monarch **MNH**							
	Rego Humic			Shaugnessy **SGY**								
	Rego (Saline)			Hussar **HSR**								

[7]CRD and VEB are used south of the Lethbridge moraine (reference). RDM is used north of the Lethbridge moraine. PUY and NEM are used in northwestern areas, and have a pinkish till associated with Willow Creek shales. [5]CLD and BKE are developed on stone-free fine-textured lacustrine, and MGT and WLG are developed on stony fine-textured lacustro-till. [5]KCH is developed on moderately fine-textured glaciolacustrine veneer over very fine glaciolacustrine. [9]JSR is a Cumulic Regosol developed on moderately fine-textured fluvial in modern stream channels. SXT is a Cumulic Humic Regosol developed on moderately coarse fluvial in modern stream channels.

APPENDIX 9.3

Table 28. Outlier communities are those sites which are unclassified due to small sample size or insufficient data.

OUTLIER COMMUNITIES IN THE MIXEDGRASS SUB-REGION								
Community	Number of Sites	*Ecodistrict	*Slope	*Drainage	*Range Site	*Landform Element	*Aspect	*Grazing Intensity
NATIVE OUTLIER COMMUNITIES								
Stipcom-Carex-Agrodas	4	MIK,CYP	gentle- level to nearly level- very gentle	RD,MWD		UNDM, terrace	SW-S-SE-UNDM	M
Stipcom-Stipcur-Agrodas	1	MIK	moderate	RD	Lo	UNDM	N	M
Stipcom-Boutgra-Agropy	1	MIK	moderate-strong	RD	SwG	UNDM	SE	H
Agrodas-Koelmac-Artefri	3	CYP	UNDM-strong-very gentle	UNDM MIX MWD	Bdl-Lo-Ov	mid slope, UNDM	VAR	L,M
Festhal-Therrho	1	CYP	nearly level	UNDM	Lo	UNDM	UNDM	UNDM
Koelmac-Chrynau-Agrodas	1	CYP	nearly level	IP	SL	UNDM	VAR	M
Koelmac-Agropy-Stipcur	2	CYP	level-<5%	WD-MWD	UNDM	UNDM	UNDM	M,L
Agrodas-Festhal-Artefri	1	CYP	gentle	MWD	BlO	UNDM	VAR	M
Poacomp-Agrosmi	1	MIK	strong	UNDM	Cy	UNDM	UNDM	UNDM
Artefri-Koelmac-Stipcom	1	CYP	UNDM	WD	BlO	mid slope	UNDM	UNDM
Agrodas-Festida-Boutgra	1	MIK	very gentle	WD	Lo	UNDM	N-NW	M
Agropy-Agrotra-Carex	1	MIK	very gentle-moderate	RD	Lo	UNDM	NE	M
Agrosmi-Stipcom-Careste	1	LET	level to very gentle	UNDM	SU	level	SW	L
Bromine-Boutgra-Stipcom	1	LET	level to very gentle	WD	Sy	level	SW	M
Glyclep-Sonculi-Solican	1	LET	level to nearly level	WD	Sy	level to terrace	VAR	M
Artefri-Poaprat-Hetevil	1	LET	UNDM	WD	Sy	level	UNDM	M
Hetevil-Artefri-Boutgra	1	LET	level	WD	Sy	level	VAR	M
Solican-Poteans-Bidecer	1	LET	level to nearly level	WD	SU	depression to level	VAR	L
Careros-Cirsarv-Solican	1	LET	level	UNDM	Cy	depression	UNDM	L
SHRUB OUTLIER COMMUNITIES								
Sympocc/Agrosmi-Solimis	1	LET	level to nearly level	UNDM	Sy	terrace	VAR	L
Sympocc-Rosaaci/Galibor	1	LET	strong	WD	Sy	mid slope	VAR	L

lists of details are in order of decreasing frequency unless separated by a dash (-), in which case they are equal. Only the major representatives are listed.
UNDM means that the details are undetermined for that site. N/A in the range site category is due to format in which site was sampled and no range site was recorded.